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Global biodiversity

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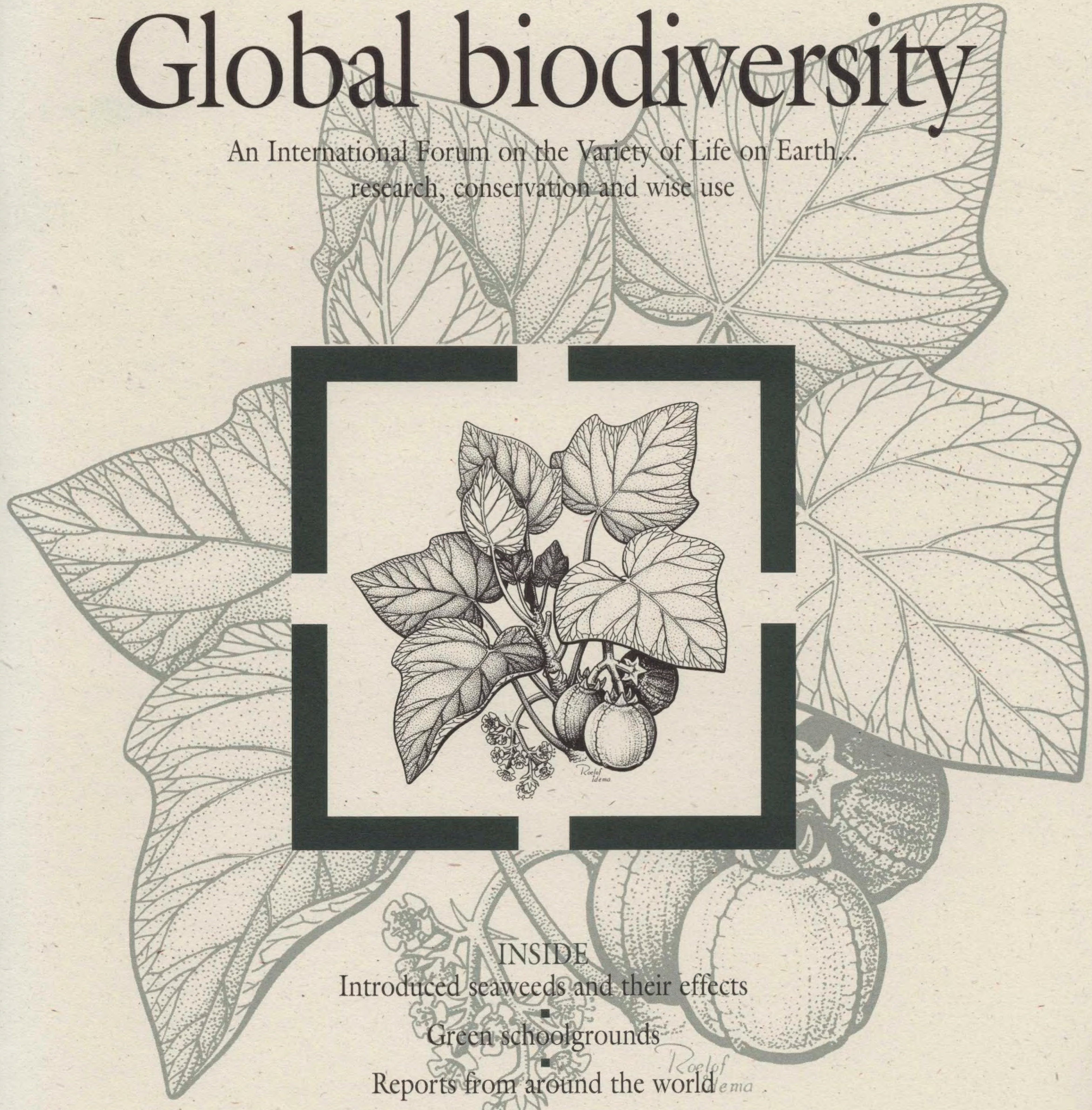

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Editor's Notebook

BACKWARD LEADERSHIP IN GOVERNMENTS AND MEDIA

In the past couple of years governments and media have lowered the priority given to environmental issues. Political campaigns have dropped positive environmental initiatives from their platforms; governments have trimmed agencies providing environmental support; and many American newspapers have cut environmental reporters (see *Sierra*, January-February 1995). Similarly, one of Canada's biggest newspapers, the *Globe and Mail*, has never replaced David Suzuki, a writer who used to include environmental issues in his regular science column. Apparently, the thinking behind this is that the public no longer places the environment high on their agenda. I challenge this on two scores.

First, public opinion polls show that the environment is high on the list of citizen concerns. Polls in Canada in 1994 and 1995 showed that the public puts the survival of life on Earth and then the welfare of their children and future generations even ahead of today's human health and safety; that Canada should be known first for environmental protection, then for human rights, then for UN peacekeeping; and 81% of Canadians polled in January 1995 said that sustainable development should be a major priority. In short, the public appears to be ahead of governments and media.

Second, in response to public demand, industry has developed a broad variety of environmentally friendly products, approaches, and services — so many it would take volumes to list them. Here are some examples:

- under its Clean Earth Campaign, **Canon** collects and recycles its toner cartridges from copiers, printers, and fax machines;
- **Husqvarna** sells a plant-based chainsaw lubricating oil;
- **The Body Shop** makes an effort to produce its soap and cosmetics from natural renewable ingredients and will refill containers;
- banks, one of the most conservative business sectors, plan to triple their investment in environment-related projects and products over the next 15 years (according to UNEP and **Salomon Inc.** of New York).

If there is wide support among the public and industry for greener initiatives, why the retrograde steps of government and media? My hypothesis is that the remaining Jurassic CEOs and corporations, less able to compete, are using behind-the-scenes pressures to thwart the wishes of the public and the enlightened private sector. Governments excuse themselves, pointing to the financial debt and ignoring the growing social and environmental debts. Too few elected officials and media executives, it would seem, have the backbone or the moral principles to stand up to these pressures and say "No!," or the vision to sustain or create the structures needed to ensure a healthy future for the family of life. Countries like the Netherlands and Scandinavia, which — through legislation and incentives — encourage the manufacture of environmentally friendly products, are helping the globe and their international competitiveness. Countries that cave in to pressures from conservative business will lose out in the global market.

Don E. McAllister

Don E McAllister
Editor

The goals of Global biodiversity are to:

- *Publish articles, views, and news on biodiversity*
- *Bridge the gaps between professional disciplines & the public*
- *Communicate vital information to help humankind make decisions on the fate of the Earth's life*
- *Express views on the needs & value of biodiversity research*
- *Provide an international forum for discussing issues on biodiversity*
- *Enhance awareness of the role of biosystematic research & museum collections to conservation & ecologically sustainable use of biodiversity*
- *Discuss methods and philosophy of biodiversity conservation*
- *Review books and periodicals on biodiversity*

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The impact of seaweed introductions on biodiversity

Robert E. De Wreede

Seven species of macro seaweeds have been introduced into the Pacific Northwest. The macro seaweeds provide food, shelter, spawning areas, and nurseries for marine organisms. This article addresses the sources of the introductions and their environmental effects, a growing concern as marine flora globalize along with economies. For more information on native westcoast seaweeds, see Global biodiversity *then known as* Canadian Biodiversity *1(3): 4. [D.E.M.]*

THE INTRODUCTION OF SEAWEED

The biological diversity of any given area is not a constant; in "human time," extinction can decrease diversity, and the introduction of new species can increase it. Theoretically it is possible that such introductions can result in the demise of one or more indigenous species (due to competitive interactions). This article considers what is known about the introduction of seaweeds to western Canadian shores, the effect these introductions have had on resident seaweeds, and compares these introductions to the introduction of marine algae elsewhere in the world.

Based on a study of shipping routes and information on species known to have been introduced, Carlton (1987) concluded that the harbours of the Pacific Northwest were one of three most likely locations in the world for a species to be introduced. Introductions to the Pacific Northwest (but largely excluding macro-algae) were recently reviewed by McQuoid and Tunnicliffe (1996), and in Table 1 the species of macro-algae algae that Lindstrom (in press) identified as being introduced into this area are listed.

In the Washington/British Columbia area, seven seaweeds (see Table 1) are known to have been introduced, or suspected of it, since about 1900. This is similar to the number of introductions known to have occurred elsewhere. Farnham (1980) reports that in southern England, 11 seaweeds have been introduced, most of

Table 1. The species of algae that have been introduced to the Pacific Northwest.

ALGAE	LOCATION OF INTRODUCTION
BROWN ALGAE	
Phaeophyta: *Sargassum muticum* Yendo (Fensholt)	Low intertidal zone, usually in semi wave sheltered locations.
RED ALGAE	
Rhodophyta: *Antithamnionella spirographidis* (Schiffner) Wollaston	Uncommon, mostly on docks in BC.
Gelidium vagum Okamura	In BC, only on Hornby and Denman Islands.
Porphyra sp.	High intertidal zone, in BC.
OTHER POSSIBLE INTRODUCTIONS	
BROWN ALGAE	
Lomentaria hakodatensis Yendo	First collected in 1959 in Nanaimo, BC; known only from there.
Caulacanthus ustulatus (Turner) Kuetzing	Northern Washington and BC; non-reproductive thalli only.
RED ALGAE	**RED ALGAE**
Ceramium rubrum (Hudson) C. Agardh	Northern Washington State.

Robert E. De Wreede, Department of Botany, University of British Columbia, Vancouver, B.C., V6T 1Z4, E-mail: <dewreede@unixg.ubc.ca>

SITE	**SEAWEED DIVISION**		
	PHAEOPHYTA (Brown)	**RHODOPHYTA (Red)**	**CHLOROPHYTA (Green)**
Washington/British Columbia			
Number introduced (%)	3 (43%)	4 (57%)	0
Number in local population (%)	143 (22%)	373 (58%)	117 (18%)
England			
Number before 1948	2	5	1
Number after 1948	1	3	0
Hawaii (since 1950)			
Number introduced (%)	1 (6%)	14 (82%)	2 (12%)
Number in local population (%)	45 (10%)	330 (72%)	80 (18%)

Table 2.
Seaweeds (by division) suspected of having invaded the sites named.

which have not caused any obvious problems, i.e. native species of seaweed or other marine organisms do not seem to have been replaced. However, the introduction there of *Codium fragile* (Sur.) Hariot (Chlorophyta, green algae) has apparently somewhat reduced the abundance of the native *Codium tomentosum*. Approximately 17 species of seaweed have been introduced in Hawaii since 1945 (Russell 1992) and their impact has also apparently been minimal.

It is, of course, not known how many seaweeds have been introduced that have not successfully adapted to their new home, or have not been observed because of their limited abundance. In a study of introduced terrestrial organisms in Great Britain, Williamson and Brown (1986) found that 10% of invaders became established, and 10% of those became pests. If similar figures apply to seaweeds, then the total number of introduced species are approximately 2 orders of magnitude higher than the number of successful introductions (see Table 2).

There are certain biological characteristics that, in theory, may predispose an organism to becoming a successful invader. Newsome and Noble (1986) summarize these for vascular plants as: "plastic perennial[s] which will germinate in a wide range of conditions, grow quickly, flower [*form reproductive structures*] early, [are] self-compatible, produce…many seeds [*gametes/spores*] which disperse widely, reproduce…vegetatively and [are]…good competitor[s] (i.e. occupier of space)." By substituting the added words in italics and square brackets for those immediately preceding them, this description can be applied to seaweeds. *Sargassum* and *Codium* have most of these qualities (see Table 3). However, physical circumstances are also important determinants of success. In fact, Newsome and Noble (1986) conclude, in part, that "environmental circumstances extrinsic to the invader are often the most important factor in determining its success." This same point is stressed by other researchers, e.g. Ashton and Mitchell (1989), and Noble (1989); Nix and Wapshere (1986) conclude that "review of an

ALGAE	**CHARACTERISTICS OF SOME INVADING ALGAE**		
	MONOECIOUS SPECIES	**VEGETATIVE/ ASEXUAL REPRODUCTION**	**ARRIVED FROM SIMILAR HABITAT**
Codium fragile (Chlorophyta, Siphonales)	no swarmers are produced apomictically	yes holdfast & parts of thallus	yes but warmer in original site
Sargassum muticum (Phaeophyta, Fucales)	yes	yes	yes
Undaria pinnatifida (Phaeophyta, kelps)	no	?	yes
Gelidium vagum (Rhodophyta, Gelidiales)	yes	no?	yes
Caulocanthus ustulatus (Rhodophyta, Gigartinales)	no (sterile)	yes	?
Asparagopsis armata/Falkenbergia rufolanosa (Rhodophyta, Nemaliales)	?	yes	yes
Bonnemaisonia hamifera/Triallella intricata (Rhodophyta, Nemaliales)	?	yes	yes
Eucheuma striatum (Rhodophyta, Gigartinales)	?	yes	yes

Table 3.
Theoretical reproductive and ecological characteristics of marine algae that may promote successful colonization of new habitats, and the characteristics of algae that have invaded new sites; monoecious refers to those algae having male and female reproductive structures on the same individual.

immense literature fails to yield any quantitative functional relationships between organismal attributes...and the probability of successful establishment in a new location." Rather "results emphasize the importance of bioclimatic matching in achieving successful establishment."

HOW DO MARINE ALGAE TRAVEL?

Carlton (1985) suggests that there are a number of ways that marine algae may travel from their home to a new location.

Ships bringing in fouling and boring communities

Carlton (1985) cites others' observations that *Codium* was seen on the hulls of ships from Europe anchored in Long Island Sound during WW II. It is ironic that Clare (1995) suggests that some of the chemical compounds in other seaweeds (e.g. the bromine-containing furanones in the red seaweed *Delisea pulchra*) show promise as antifouling compounds that can be used on ships' hulls.

Undaria pinnatifida (Harvey) Suringar (brown algae) was introduced to Golfo Nuevo, near Puerto Mardryn on the central Argentine coast, reportedly by attaching itself to cargo ships or fishing boats from Asia, where the species is native (Casas and Piriz 1996). Similarly, *Asparagopsis armata* Harv. (red algae) is assumed to have been brought to England on ships (Farnham 1980). While *Undaria* was introduced as a commercial species in the waters off France, Floc'h et al. (1996) believe it has spread to other sites by attaching itself to ships' hulls; this theory is based partially on its appearance in local harbours. Hay (1990) also reports that *Undaria* is spreading in New Zealand also by attaching itself to ship's hulls.

Semisubmersible exploratory drilling platforms as transporters

Fouling organisms travel on drilling platforms in much the same way as they do on the hulls of ships, discussed above.

Seawater ballast of ships as a carrier

Kelly (1993) examined the ballast water of ships transporting wood to Japan and found many different micro-algae and their spores and cysts. She does not report finding any spores or other potential dispersing agents of macro-algae. However, the introduction of *Undaria* into Tasmania probably occurred in this manner, just prior to 1982, in ballast water from wood-chip ships arriving from Japan (Sanderson 1990). These ships carry in excess of 25,000 tonnes of ballast water, which includes sediments.

While the physical conditions in ballast tanks undoubtedly affect the likelihood of survival of algal spores, gametes, and thallus fragments, these organisms can survive many conditions. For example, some algal spores/micro-gametophytes are able to survive as long as 30 days in total darkness (Kain, 1964; Klinger, pers. com.); however, if germination and attachment occurs while in the ballast tanks, it is highly unlikely that the partially developed algae will be able to re-attach themselves once they are expelled. Some conditions in ballast water (e.g. salinity and nutrients) are probably similar (during travel) to those where the water and any algal propagules were taken in, but toxic compounds, such as oils and solvents draining into the ballast waters, may drastically reduce the likelihood of survival.

Since it is likely that any viable seaweed propagules carried by ballast water will be spores or microscopic pieces, how likely is it that such material will give rise to viable recruits once released? This depends in part on the nature of the potential settlement site. For example, the absence of appropriate herbivores at the new site could enable a population to become established. It is likely that there is a density limit of male and female algae below which sexual reproduction is not successful, although just what this limit is is unknown. For this reason asexually reproducing populations are more likely to become established.

Purposely introducing species and their epiphytes and epifauna, and organisms caught in fishing nets

Sargassum muticum may have arrived as packing material when the oyster (*Crassostrea gigas* Thunberg) was imported from Japan to the west Pacific coast (Scagel, 1956), probably before 1940. Once introduced, dispersal was facilitated by the surface drift of fertile material, by pleasure craft entanglement, and transport of oysters within local areas (Critchley et al., 1990). Perez et al. (1981), Riouall (1985), and Boudouresque et al. (1985) report that at least three species of brown algae — *Laminaria japonica* Areschoug, *Undaria pinnatifida* (Harvey) Suringar, and *Spaerotrichia divaricata* (C. Agardh) Kylin — were introduced into the Mediter-ranean with *Crassostrea virginica* Gmelin from Japan, as was *Sargassum muticum* in France, and *Colpomenia peregrina* (Sauvageau) Hamel (Farnham 1980) in England. *Undaria pinnatifida* has probably also been introduced into New Zealand (Hay and Luckens 1987) and Tasmania (Sanderson 1990) in packing material. All of the above are brown algae.

THE EFFECT OF SEAWEED INTRODUCTIONS

The effect of introduced seaweeds on local species is known from only a few experimental studies, and from anecdotal evidence. De Wreede (1983 and 1978) studied the phenology (seasonal variation in growth and reproduction) and interaction of *Sargassum muticum* with other (presumably native) species of algae in the Strait of Georgia, British Columbia. These experiments involved clearing plots of algae, helped by a concurrent (fortuitous) outbreak of sea urchins that grazed selectively on *S. muticum*, and resulted in the interpretations shown in Figure 1, and summarized below:

1. *S. muticum* was limited in this area to the low intertidal zone and patches of the shallow subtidal zone; it had not invaded the total extent of these zones.

2. In general, when a disturbance occurred (Figure 1), which made primary substratum available in what can now be described as the *S. muticum* zone, the seaweed was able to colonize relatively rapidly and dominate the site.

3. If a similar disturbance occurred when *S. muticum* was absent (as happened due to intensive grazing by sea urchins), *Neorhodomela larix* (Turner) Masuda (a native red algae) was able to dominate the site, and subsequently was able to keep out the introduced species, *S. muticum*.

4. I propose that before the introduction of *S. muticum, N. larix* was predominant in this zone. The introduction of *S. muticum* reduced the dominance of (but did not exclude) *N. larix*. No other effects were observed in these studies.

The conclusions were similar for a zone lower in elevation in this same intertidal area.

Floc'h et al. (1996) studied the settlement of the introduced species *Undaria pinnatifida* in experimental clearings made on the Atlantic coast of France. Strips perpendicular to the shoreline were cleared of algae from the intertidal to subtidal zones, in areas of varying wave exposure and distance from an existing *Undaria* farm. Within three months, sparse settlement occurred (20 sporophytes — the visible and dominant stage in the life history — and only in the cleared sites most exposed to waves), and all of these were gone within nine months. The transects were then checked every year, and no *Undaria* was found again until July of 1993, when 26

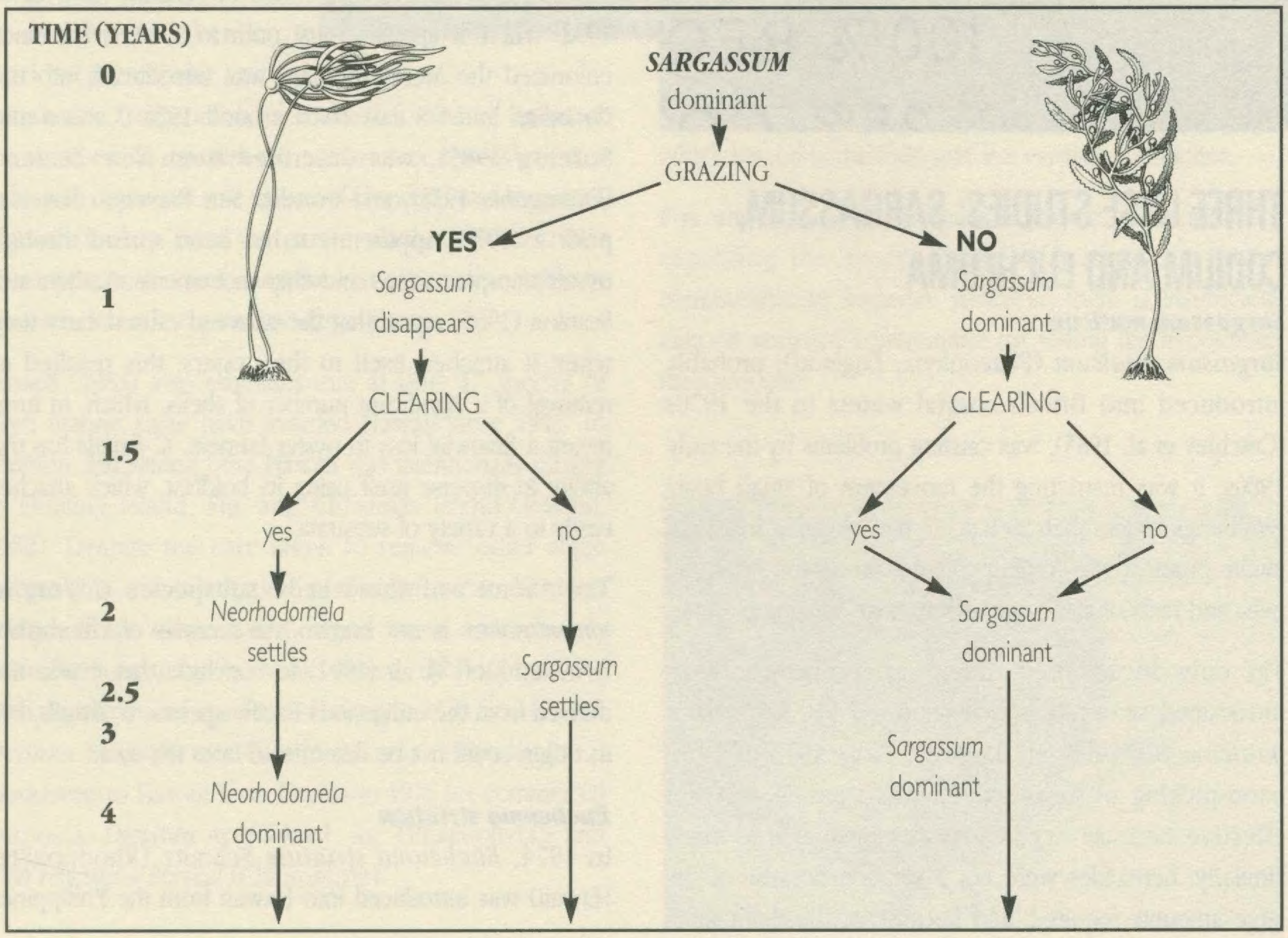
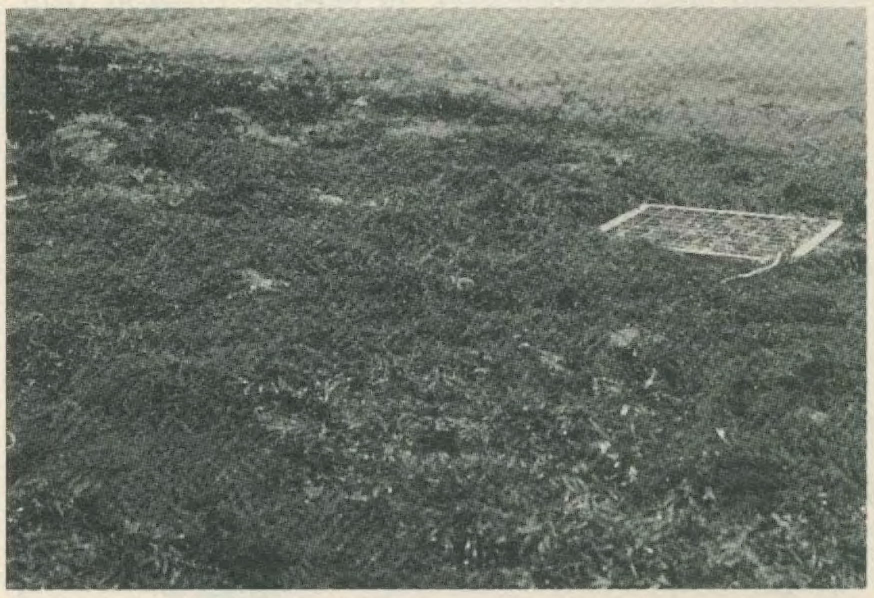


Figure 1.
Effect of grazing and disturbance (clearing) on reconstitution of the dominant algae (*Sargassum muticum* and *Neorhodomela larix*) in a low intertidal community in the Strait of Georgia, British Columbia.

thalli were growing in control (unmanipulated) and in previously cleared (but now naturally regrown) sites; some of the *Undaria* plants were a metre long and forming sporophylls. Floc'h et al. (1996) concluded that *U. pinnatifida* was not replacing the indigenous species of algae, but that it had now become established in the Atlantic.

In a survey of the effect of introduced (non-seaweed) species, Simberloff (1981) concluded that, in general, introduced species have little or no effect on the communities they invade. Of the 850 plant and animal introductions studied, less than 10% led to the extinction of other species. However, these conclusions have been questioned on a number of grounds by Pimm (1991), who re-examined the papers cited by Simberloff (1981) and concluded that there were many effects of introductions other than extinction, such as changes in the abundance of other species.



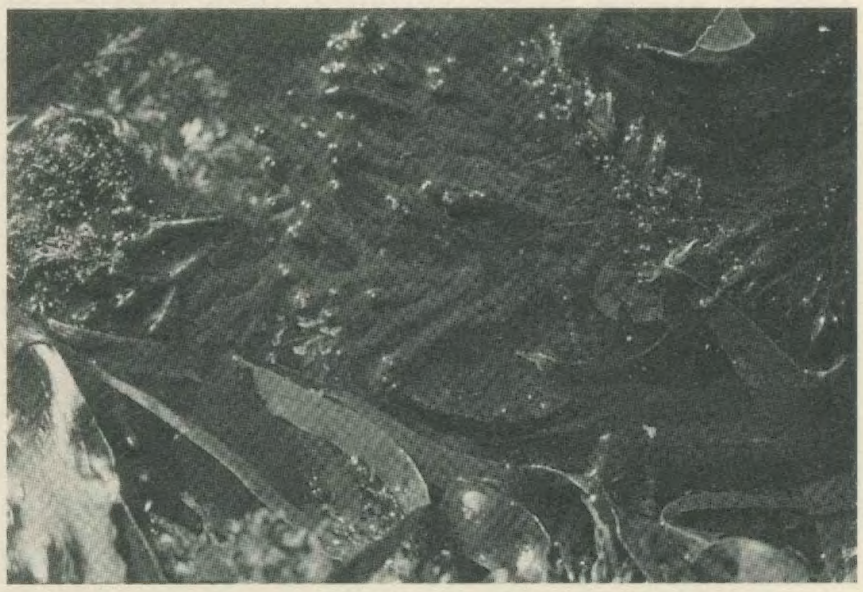
Here in the Strait of Georgia, British Columbia, Canada, *Sargassum muticum*, a brown algae and an introduced species, is covering much of the intertidal area. (Photo by R.E. De Wreede)

THREE CASE STUDIES: SARGASSUM, CODIUM AND EUCHEUMA

Sargassum muticum

Sargassum muticum (Phaeophyta; England), probably introduced into British coastal waters in the 1970s (Critchley et al. 1985), was causing problems by the early 1980s: it was restricting the movement of small boats (with engines less than 20 h.p.); it was clogging industrial intake pipes; it was fouling commercial fishing lines and nets; and mats of algae cast ashore were causing odours.

The only documented attempt at eradication of an introduced seaweed is that reported for *Sargassum muticum* (Critchley et al. 1985). From 1973 to 1976, hand-picking of the seaweed was tried. It was not effective because zygotes spread into cleared sites. Similarly, herbicides were not a solution because of the large amounts required, and because of the detrimental effects they had on other algae. The biological control of molluscs, amphipods, sea urchins, and the sea hare were tried but none were effective. Critchley et al. (1985) report that grazing by littorines (small snails) may even aid in dispersal of *Sargassum* by breaking off fronds that contain mature reproductive structures. Mechanical clearing, by trawling, cutting, and suction, was tried. Both the cutting and trawling methods had problems when it came to retaining and handling the cut weed. The suction method was not effective where *Sargassum* existed in high densities. No use was found for the harvested *Sargassum*.



A species of the genus *Codium*, a green algae, has been introduced to the eastern shores of North America, where it is causing problems for shellfish farmers. (Photo by R.E. De Wreede)

Codium fragile

Codium fragile (Chlorophyta; Western Atlantic and elsewhere) subsp. *tomentosoides* (van Goor) Silva (Chlorophyta) was first described in Holland (Goff et al. 1992) where it appeared just prior to 1900. It has since colonized the Mediterranean, was introduced into the Canadian and US east coast around 1956 (Carlton and Scanlon 1985), was described from New Zealand (Dromgoole 1975), and invaded San Francisco Bay just prior to 1979. Apparently it has been spread through oyster transplantations and ship movements. Carlton and Scanlon (1985) report that the seaweed caused extra drag when it attached itself to the oysters; this resulted in removal of a significant number of shells, which, in turn, meant a financial loss to oyster farmers. *C. fragile* has the ability to disperse itself using its holdfast, which attaches easily to a variety of substrata.

The "home" of the weedy subspecies *C. fragile tomentosoides* is not known. An analysis of chloroplast DNA led Goff et al. (1992) to conclude that it was not derived from the indigenous Pacific species, *C. fragile*, but its origin could not be determined from the data.

Eucheuma striatum

In 1974, *Eucheuma striatum* Schmitz (Rhodophyta; Hawaii) was introduced into Hawaii from the Philippines

Eucheuma and *Kappaphycus* are farmed in many areas where they are native, such as this farm in northern Sulawesi, Indonesia. From sites such as this one, species of these genera have introduced to many other areas, e.g. Hawaii and Fanning Island. (Photo by R.E. De Wreede)

as part of an experimental program on carrageenan-producing algae. Studies (Russell 1983) indicated that escaped populations were maintained by fragments drifting in from the planted sites. When the experimental plantings were removed, the escaped populations disappeared. The author concluded that *Eucheuma* did not displace native algae, although it did cause some mortality in corals by shading (within 74 days), and that it increased the diversity of animal species in its neighbourhood, apparently by providing shelter and food. In tests of herbivory, juvenile scarids (parrotfish) and acanthurids (surgeonfish) accounted for heavy losses of the seaweed. *E. striatum* did not produce spores/gametes in Hawaii, hence its sole means of dispersal was by pieces of thalli broken from the parent plants. Russell (1983) states that, on the reef, most broken pieces are unable to re-attach, but a few grew into large plants.

Fanning Island, Canada, where several marine algae are reported to have been introduced. (Photo by R.E. De Wreede)

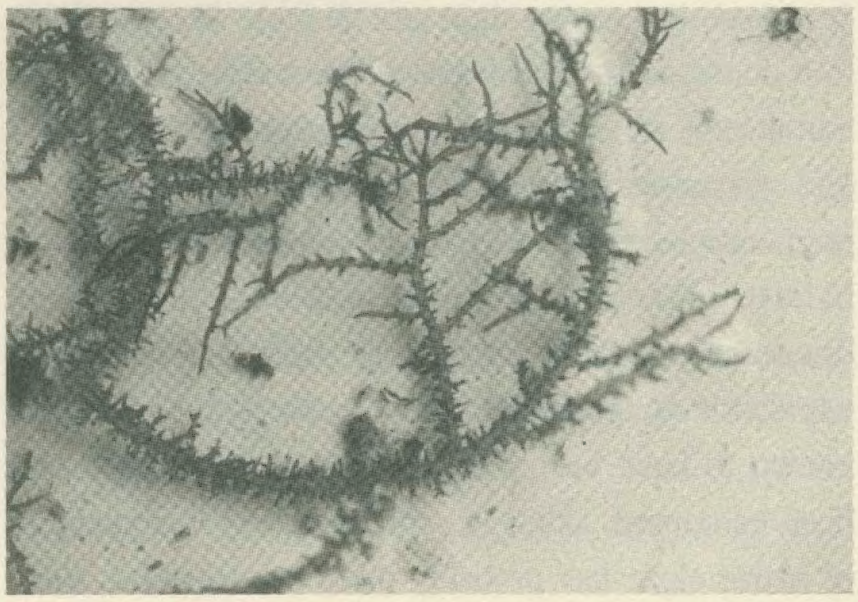
Russell (1983) also estimates that at least 17 species of alien marine algae have invaded Hawaii since 1945. In addition, *Eucheuma* from Hawaii was intentionally moved to Fanning Island, Fiji, and Christmas Island (Russell, 1982). Despite the care taken to remove other algae during this transplantation of *Eucheuma* to Fanning Island, four other alien algae were introduced: *Acanthophora spicifera* (Vahl.) Boerg. (Rhodophyta) — itself an introduced species to Hawaii in 1950 from Guam: *Hypnea musciformis* (Wulfen) Lamx. (Rhodophyta) introduced to Hawaii from Florida in 1976 for commercial purposes; *Dictyota acutiloba* J. Ag. (Phaeophyta); and *Ulva reticulata* Forskal (Chlorophyta).

COMMUNITY RESISTANCE TO INVADING SPECIES

A variety of ecological theories can be applied to predict the success or failure of an invading species. Pimm (1991) theorized that if a vacant niche is available, then the invading species has little effect on the species already present. This was supported by data from Bergman and Carlton (1991), who examined two possible explanations for the successful invasion of the snail (*Ovatella*) in marshes of the Pacific coast of North America. They rejected the hypothesis of competitive superiority, and suggested instead that *Ovatella* inhabited a new niche, a semi-terrestrial environment not used by local species; as a result, no native species were replaced or displaced. However, it is notoriously difficult to recognize an "empty" niche prior to its occupation.

An invading species may also be successful because it has no predators or competitors in the new community. A generalized herbivore, without competitors, in a relatively simple community (simple food-web) would be expected to have the greatest impact when introduced. For the algae, a high-impact species would be one placed in a relatively simple community, which has no herbivores, and is a capable competitor.

Fox and Fox (1986) discuss a variety of hypotheses regarding the susceptibility of natural terrestrial communities to invasion. However, there is insufficient data on seaweed communities for testing the hypotheses they propose.



Hypnea spinella, a red algae, similar to the species introduced to Fanning Island. (Photo by R.E. De Wreede)

Table 4. Estimated rate of spread by seaweed species following their initial discovery.

SPECIES	RATE OF MOVEMENT	SOURCE
Sargassum	**England** East 10 km/yr West 23	Critchley et al. (1983)
	France East 73 West 88	Critchley et al. (1983)
	Eastern Pacific South 80	Scagel (1956); and author's estimate from litterature.
Codium fragile	**Western Atlantic** N.E. 100	Ramus (1971)

QUANTIFYING/ MODELLING THE INVASIVE PROCESS

The rate at which an invasive seaweed spreads is dependent on such variables as currents, reproductive capacity of the seaweed, the help they get from humans, and their ability to adapt to new sites. While none of these variables are easily quantified, and none have been to date, the rates of spread of a few seaweeds can be estimated from the literature (Table 4).

It seems likely that many more species of seaweed have been introduced than we know about. However, based on what we do know, such introductions have added to the species diversity of an area, and are not known to have eliminated any species. Article 8 of the International Convention on Biological Diversity proposes (in part) "to prevent the introduction of...alien species which threaten ecosystems, habitats or species." Given the paucity of our knowledge about the impact of introduced seaweed species, all such introductions should indeed be avoided.

SUMMARY

Seven marine macro-algae are thought to have been introduced to the Pacific Northwest. The methods of introduction for many of them are unknown, but fisheries and shipping introductions seem the most likely mechanisms. Introductions of macro-algae by means of ballast water are possible, but none have been documented. The impact of algal introductions worldwide is apparently minimal. No algal species are known to have been eliminated because an algae has been introduced, although some reduction in abundance of native algae has probably occurred. However, there are no long-term studies on such introductions. Few formal ecological studies have been done on introduced macro-algae, and the apparent increase in algal introductions suggest these should be undertaken. Given our limited knowledge about the impact of introduced algae, all such introductions should be avoided.

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Schoolyard greening: The biodiversity connection

Ann Coffey

The developed world is becoming increasingly urban. Canadian demographics show that more than 75% of the population lives in or around urban centres. This is an increase from 100 years ago when less than 50% lived in cities and towns. More leisure time is being spent indoors linked to electronic media. As society removes itself further and further from a direct experience of nature, how will future generations understand and appreciate the value of biodiversity? The author suggests that re-introducing nature into the schoolyards may be one solution. [D.E.M.]

SCHOOLYARDS TODAY

No one would want to leave children in an empty room to play, but every day in Canada we leave hundreds of thousands of children in desolate schoolyards for up to 28% of the school day with very little to do.

The majority of playgrounds are still of the flat asphalt type with fixed equipment selected from a catalogue. Although years of fund-raising are often required to purchase play structures, recent studies have shown that they are only in use between 2% and 14% of the time (Learning Through Landscapes Trust, 1990). Schoolyards rarely have grass, trees, flowers, animals, or any natural beauty. Children are increasingly condemned to live in harsh, stark environments with hard surfaces. They cannot be expected to grow where nothing else does.

It is interesting to consider that both children and young chimpanzees are placed in environments that are not "natural" but that have been structured for them. Environments created for chimpanzees are planned with far more science, art, and attention to the animals' needs and potential than those of our own children.

EFFECTS OF TODAY'S SCHOOLYARDS

A two-year study (Titman 1994) of thousands of children across Britain focused entirely on children's responses to their school grounds. The results clearly demonstrate that attitudes and behaviour are directly influenced by the quality of the environment. Children consistently described the asphalt and concrete surfaces as gray, bleak, ugly to look at, and found asphalt unpleasant, uncomfortable, boring, and dangerous. They also mentioned that such an environment yields nothing and produces no response in terms of sensations, other than pain and "getting your clothes torn." For some children, the asphalt was symbolic of the economic status of their school; they expressed the view that asphalt was all their school could afford and deduced from this that hard surfaces were a measure of the worth of the school and of themselves as part of it.

For the past 140 years, there have been several attempts made to transform Canadian school grounds with the impetus for this coming largely from the European school movement. Some school gardening initiatives have focused simply on beautification or protection "from the fierce heat of summer and the storms of winter," while others have promoted the health of the school's population and the development of the "symmetrical education of the individual." Today, tree planting is recommended to provide shade to help protect children

Which is better: a "green" schoolyard as seen in this school in the south of England, or a schoolyard covered in asphalt? Can children be expected to grow where nothing else does? (Photo: Ann Coffey)

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from exposure to the sun's harmful UV radiation. Vegetation also helps absorb air pollutants and reduces the costs of air conditioning and heating the school.

SCHOOLYARDS IN THE OLD DAYS AND THEIR EFFECTS

In Canada from 1900 to 1910, the school garden became an outdoor classroom, providing space to teach math, business practices, mechanical drawing, entomology, chemistry, botany, and physical geography. These gardens were believed to teach civic virtues — "the private care of public property, economy, honesty, application, concentration, self-discipline, civic pride, justice, the dignity of labour, and the love of nature." In other words, school gardens helped produce good, responsible citizens who would contribute to society.

By 1915, school gardening was recognized by leading educators as a very important factor in the health and education of the child, and in making our cities more beautiful and desirable places to live. A marked decrease in juvenile delinquency was reported when school and community gardening was implemented. Towards the end of the 1940s, school gardening declined. School Victory Gardens were replaced with formal plantings of trees and lawns, and designated play spaces were covered with asphalt or gravel.

THE GREEN SCHOOL RETURNS

A resurgence of interest in school gardening began in Britain in 1986. In only nine years, the British model proved remarkably successful in reducing antisocial behaviour, such as violence and vandalism, and in improving the environmental, educational, and social quality of school property. This has led to an international movement to create a wide range of outdoor classrooms on school grounds.

In Britain alone, there are now well over 10,000 schools actively engaged in transforming their grounds from desert-like expanses of asphalt and grass into rich and diverse spaces for learning and playing. Teachers are discovering that hands-on activities in outdoor classrooms help them cross traditional subject boundaries and make learning more interesting. Educators report that attitudes and behaviour have improved dramatically with the development in children of a sense of ownership, a sense of place, and a sense of belonging to a place. Adding interest to play spaces has resulted in a decrease of up to 80% in school-yard accident rates, and both absenteeism and drop-out levels decline as school life becomes more meaningful.

Educators report that greening schoolyard projects lead to dramatic improvements in behaviour and attitudes.
(Photo: School Garden Guidelines, City Farmer, Vancouver)

Some progressive Canadian school boards support the efforts of individual schools wishing to transform their grounds. For example, the Strategic Plan of the Wellington County Board of Education in Ontario includes facilitating the establishment of mini environmental education centres on every school site. Students in 43 schools of the Waterloo County School Board (also in Ontario) are working on naturalizing their grounds.

The purpose of developing school grounds is to transform them, with the active participation of students, teachers, parents, and members of the wider community, from barren rectangles of asphalt and lawn monocultures into living outdoor classrooms and exciting social spaces that provide for both active and passive activities. It represents the best community model for ecological restoration, the infusion of environmental education across the curriculum, the integration of all subject areas, and community building through community involvement.

Thousands of examples in Britain, Europe, and elsewhere have shown that the scope of grounds' transformations is limited only by the reach of the imagination. The more diverse the approach, the greater the potential for integrating all areas of the formal, as well as the "hidden," curriculum.

Outdoor classrooms can embrace virtually anything, including: habitat restoration and creation; butterfly meadows, ponds, insect gardens, woodland, and hedgerows that provide food and shelter for small

Outdoor classrooms are an important way of reconnecting students with the natural world through experiential learning. (Photo: Ann Coffey)

mammals and birds; artistic creations such as sculpture gardens, giant chess boards, wall murals, and pavement paintings; nurseries of native trees, shrubs, and wildflowers; and vegetable, fruit, berry, perennial, herb, and rock gardens. Bats and birds can be attracted to the site by installing roosting boxes, nesting boxes, and feeders. Composting gardens can be built to prevent organic waste from being sent to landfills and to save money by reducing the need for commercial fertilizers.

The development, use, and maintenance of outdoor classrooms is an important way of teaching the meaning of ecology, and of reconnecting people with the natural world through experiential learning. The importance of planting indigenous trees and shrubs to provide habitat for native species can be learned first-hand, and children can learn the names of their own regional flora. Edible gardens can be effectively used to introduce students to the environmental, health, social, and economic impacts of our current food production and delivery system — loss of biodiversity; pesticide, energy, and water use; global climate change; international trade; nutrition; and social justice and human rights issues.

An article published in 1987 by the Evergreen Foundation on school gardens in Vancouver stated that 95% of the children involved in school gardening projects there were "apartment dwellers who did not even know what a plant was." Nature interpreters across Canada confirm that a high percentage of urban children do not even understand that plants are living things. They also report that children are afraid to be out in nature "once the pavement ends."

School grounds projects designed to bring nature back into our daily lives are crucial for the long-term conservation, protection, and restoration of wild spaces. Most children never have the opportunity to directly experience wilderness, and many living in urban settings have very limited opportunities to explore natural environments. Increasingly, visits to outdoor education centres are limited by financial constraints. Learning about the natural world and the need to protect biodiversity tends to come mostly from printed and electronic sources. Teaching about nature in this way is an academic abstraction that ignores the value of learning through the senses throughout childhood to develop an ecological consciousness.

Nature, it has often been stated, is our best teacher. Yet the ground at our feet in Canada's 18,000 or so schools has in recent decades been ignored as an ideal place to develop a living curriculum for accomplishing humanity's greatest task — that of reconnecting with the natural world in order to teach how to work *with* other living things and natural cycles and processes instead of *against* them.

Changes are beginning to take place. The list of schools enthusiastically embracing the concept of greening school grounds has grown exponentially in Canada over the past year, thanks largely to the efforts of the Evergreen Foundation.

This Toronto-based foundation has hosted a series of seven "Learning Grounds" conferences across the country to provide schools and communities with the tools they need to get started. Evergreen also helps fund school grounds naturalization projects.

If your local school grounds are nothing but a wasteland of hard surfaces and pounded grass with enormous potential for changing our relationship with the Earth, perhaps it is time to support this movement.

For further information, contact: The Evergreen Foundation, 24 Mercer Street, Toronto, Ontario M5V 1H3, Canada, Tel: (416) 596-1495; Fax: (416) 596-1443 or the author (at the address listed on page 10).

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Can we predict the fluctuations of ecosystem species richness?*

Marc Proulx

Today the world is burgeoning with environmental problems; at the same time, the number of scientists and experts appears to be dwindling due to scarce resources and the drive to eliminate deficits. How, then, to best focus conservation dollars? Who decides? Some scientists have suggested that one solution may be to spend conservation dollars on ecosystems that are both rich in a diversity of species and most vulnerable to change. In this paper, the author examines the state of the current research available and comments on the reliability of predicting environmental effects on ecosystems. [D.E.M.]

INTRODUCTION

The Earth Summit, held in Rio de Janeiro in June 1992, helped bring to light the profound changes that are taking place in our planet's ecosystems. Species richness (also one of the components of biodiversity) is decreasing at an alarming rate. And the consequences of this decrease are hard to predict. Nevertheless, specialists agree that the magnitude of the problem is such that we have to put an end, first and foremost, to this phenomenon or at least slow it down (Wilson, 1988).

Since the Earth Summit, 169 states have embarked on that path by signing the Convention on Biological Diversity (Sirica, 1994). This is a huge commitment — it embraces objectives as ambitious as the development of strategies for the conservation of biodiversity that still stimulate social and economic development (Prescott, 1994). In concrete terms, these objectives include, among others, the development of taxonomic inventories, site development that promotes the flourishing of native biodiversity, and the development of models to predict the impact of environmental disorder on species richness in a community (Proulx and Bénard, 1994).

Species richness is, therefore, more than ever, at the heart of many scientific studies. Some of these take the shape of taxonomic inventories based on biogeographical regions, on specific ecosystems, or on specific groups of organisms (Groombridge, 1992; Poulin et al., 1995). Such quantifications are often used to compare total ecosystem species richness and then identify sites that are biologically very diversified (May, 1990; Sournia et al., 1991). Research on ecosystem biodiversity is not limited to carrying out inventories and identifying species. In fact, scientists are interested in the origin (Benton, 1995) and the role (Schulze and Mooney, 1993) of biodiversity, as well as the development of sampling strategies and the means to efficiently quantify species richness (Pielou, 1975).

The comments presented in this article will focus on the development of models that predict the reaction of species richness to an environmental stress of natural or anthropogenic origin. This last aspect of scientific research is intrinsically tied to our capacity to manage our environment and to achieve the conservation objectives as defined at the Earth Summit.

IS PREDICTING THE EFFECT OF ENVIRONMENTAL STRESSES EVEN POSSIBLE?

One of the main challenges of present-day ecology is to predict the impact of climatic change, ozone layer depletion, fall-out from industrial pollutants, overfishing, and other current environmental concerns on ecosystem species richness, with the goal of protecting that richness. To my knowledge, it is still risky to try to predict the reaction of ecosystem species richness to an environmental stress, be it natural or anthropogenic.

*Translated from French. Adapted from the predoctoral paper presented by the author to the Département de sciences biologiques of the Université de Montréal.

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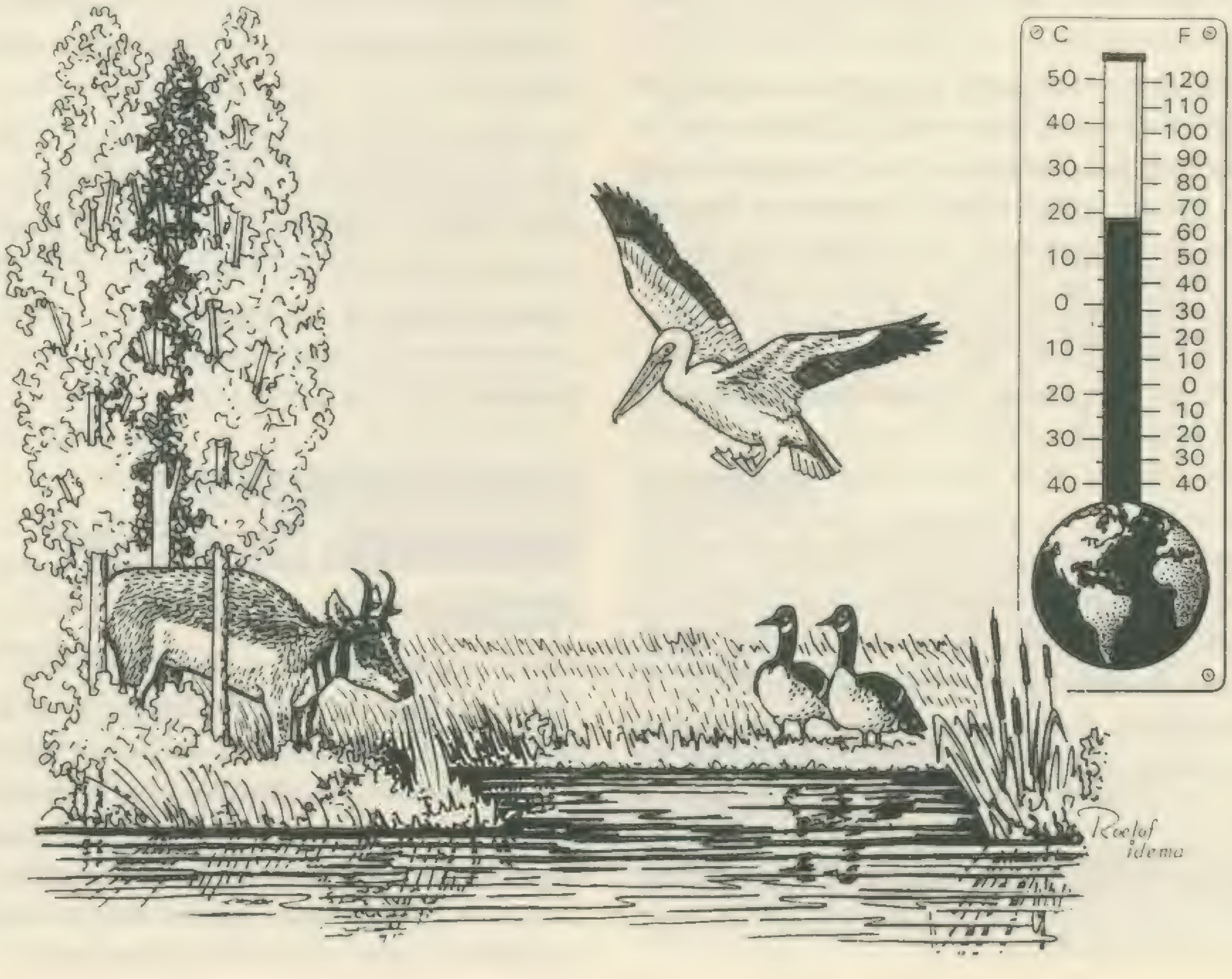
The problem with predicting species richness does not lie in the lack of research on the subject. Many theoretical models have been published along with a plethora of factors giving empirical descriptions of the variability of species richness in terms of several environmental characteristics. Nevertheless, no one theory or empirical relationship seems to be unanimously approved by the scientific community. In fact, in spite of the array of factors contributing to an empirical description of the variability of ecosystem species richness, there is no agreement on the mechanisms that govern this richness. Very few of the empirical models dealing with the variability of species richness at the ecosystem level have achieved "testability," the scientific criterion put forward by Popper (1959). Consequently, the predictive ability of existing models is limited, often by the lack of precision at the level of formalization of the operating concepts, and sometimes by the lack of quantifying tools required to carry out experiments (Peters, 1991). Thus, several of the mechanisms explaining species richness and community structure in general are based on interactions (e.g., inter- and intraspecific competition) or concepts (e.g., intermediate stress) that are still difficult to quantify despite numerous attempts at modelling them.

THE NEXT STEP: TESTING MODELS WITH PREDICTIVE POTENTIAL

In order to better understand the laws that seem to control ecosystem species richness, we must develop, from the existing models (that seem to have good predictive potential), hypotheses that can be rejected, and test them. This step is essential for the study of species richness in a scientific context since it allows us to identify the models that have a high predictive ability.

Several recent monographs devoted to the advancement of scientific research on the variability of ecosystem species richness attempt to solve the problem by suggesting new conceptual frameworks (Ricklefs and Schluter, 1993; Huston, 1994). Testing of the hypotheses on which these conceptual frameworks are based will probably lead to a better understanding of the laws that control ecosystem species richness. We will eventually be able to use the large number of empirical (or observed) relationships on the variability of species richness described in the scientific literature (Palmer [1994] lists more than 120 in a review paper) to complete that task. Given the array of factors already described, the empirical (or observed) relationships of species richness tend to be grouped in large categories according to a theme or common characteristics. Some examples follow:



What will be the effect of global warming on temperate species-rich ecosystems such as prairie potholes?

- One of the most commonly used classifications combines factors tied to empirical patterns according to their geographical, physical, chemical, or biological nature.

- Another classification is based on the spatial scale. The empirical patterns that develop from the variability of species at the local or ecosystem level are grouped together but treated separately from the pattern developed from the variability of species at the global or intercontinental level (Ricklefs and Schluter, 1993).

- A certain number of alternative categories are also used. They are, in general, based on functional groups, such as trophic levels (Schulze and Mooney, 1993), or historical factors.

Whatever the classification used, the objective stays the same: to identify the key factors or the common traits of several empirical relationships.

Several studies — experimental, empirical, or theoretical — and some reviews pave the way to a new research field on species richness by suggesting that the study of the interactive effects of different factors can allow us to better understand the variability of empirical relationships. The impact of interactive effects on major empirical relationships dealing with the freshwater environment (Mazumder, 1994) demonstrates quite well the potential application of this approach. Already, preliminary results seem to indicate that such an approach will allow us to better predict the impact of environmental change on ecosystem species richness. The results of an experiment carried out in nature show the importance of the interactive effect of the impact of predation and the availability of nutrients on plankton species richness and the variability of the empirical relationship between diversity and ecosystem productivity (Proulx et al., 1996).

CONCLUSION

If the scientific community wants to be able to better predict the variability of ecosystem species richness, it will have to rise to the challenge of developing and testing a model that takes into account the ubiquitous relationships of species richness (e.g., the relationship between productivity and diversity), and that can be applied to milieu as diverse as terrestrial, marine, and freshwater environments. Only the future will tell us if the study of interactive effects will allow us to better predict the variation of ecosystem species richness.

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Do medicinal plants have a place in today's medicine?*

N.N. Malo[1] and R. Roy[2]

Modern scientific methods are exalted, even revered, as the solution to many modern problems, particularly in the field of human health. However, for centuries before "modern science" came into its own, native peoples around the world healed themselves by using the plants around them. The authors point out that it behooves modern researchers, such as themselves, to combine traditional knowledge about the healing properties of plants with modern research methods to discover new drugs and cures. They also stress that action is required immediately to preserve the diversity of plants and the knowledge of traditional healers before both disappear. [D.E.M.]

INTRODUCTION

Through its beauty, lushness, and generosity, nature sustains and nourishes us all our lives. It is an immense laboratory capable of synthesizing all the drugs that we could possibly need to maintain our health and our physical and moral equilibrium.

Apart from its magnificence and direct relationship to our health, nature is a valuable source of dyes, alkaloids, essential oils, lipids, and numerous other economically and industrially important chemicals.

Some complex natural products, easily synthesized in nature, are difficult to replicate in the laboratory. Since the beginning of time, humans have sought these useful chemicals, hidden in the leaves, roots, stems, and bark of plants, to fight disease and ensure of a better state of health (Ahyi 1991).

DOES TRADITIONAL MEDICINE HAVE VALUE TODAY?

In traditional African societies, like everywhere else, health is considered to be a state of equilibrium that cannot be defined or quantified accurately. It is an invaluable possession that everybody wants to have and keep forever; it is priceless and remains everybody's major concern (Ahyi 1991).

Unlike modern or conventional medicine institutionalized by Hippocrates in ancient Greece, traditional medicine dates from the beginning of humankind. Despite spectacular scientific advances, particularly in the health field, phytotherapy (using plants for medicinal purposes) has not lost any of its popularity or importance. In the developing world, particularly sub-Saharan Africa, more than 80% of the population use traditional medicine almost exclusively (Adjanohou et al 1987; Adjanohou et al 1989; CSTR/OUA 1985; Iwu 1993).

Humans use many of the huge variety of plants indigenous to Africa to make drugs, perfume, beauty care products, and as a source of food. But, in this era of antibiotics, genetic engineering, and high-tech surgery, when scientists are making such fantastic technological and medical discoveries, is it fair to expect them to rediscover the "basics," the medicinal plants? At first glance, this seems to be a paradox. After all, these plants have been, since time immemorial, part of the heritage of ethnic groups and cultures on every continent (Pelt 1992). It is hard to condemn a tradition validated by millennia of use; more and more prominent scientists are taking great care to avoid doing so.

Today, nearly 12 million French citizens, or 27% of the population, mostly women, use plant products (Adjanohou et al 1987; Casgha 1992). On their list of needs are gentle relief from the chronic ills of our society, especially stress, anxiety, and digestive problems.

*Translated from French

Visitors to Ottawa: Take note.
"Nature's Pharmacy" is an exhibit on the fourth floor of the Canadian Museum of Nature in Ottawa. In an interactive way, it explores plants and their healing qualities, drawing on both traditional practices and western science for its information.

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And yet, ten years ago, phytotherapy was considered an absurd relic, albeit innocuous. The few scientists still studying it were considered obscure dinosaurs of the medical world, tolerated but still considered eccentric (Novisti 1991; Ford 1975; Le Floch 1983).

Today, medicinal plants are at the heart of many highly regarded symposia and congresses. Having regained their esteem in the eyes of the pharmaceutical world, arrays of pills made from plants are invading drugstore shelves.

AFRICA

In the West African sub-area (Benin, Burkina Faso, Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra Leone, Togo), more than 5,000 species of plants are commonly used by the rural population (Adjanohou et al 1989; CSTR/OUA 1985; Iwu 1993).

Three concepts characterize the use of medicinal plants in this sub-area, and on the whole of Africa: the sociocultural concept, empiricism, and the complexity of drug formulation that sometimes makes it difficult to develop this resource (Ahyi 1991; Novisti 1991).

It is estimated that the world is home to almost 250,000 plant species, one tenth (25,000 species) of which are medicinal. According to specialists, 1,400 of the 10,000 plants found in African forests produce potentially anticarcinogenic compounds. Very few of them are well known or commercially exploited, even though 50% of our traditional drugs are closely related to plants (Iwu 1993). These statistics give a clear picture of the work still to be done to develop this vast resource in order to achieve equilibrium in our biosphere.

There is no doubt that in these West African forests there are plants that heal. Some of them are toxic and generally considered sacred, while others, because of their uncontrolled use as hallucinogens, have given a bad name to traditional medicine and medicinal plants (CSTR/OUA 1985; CSTR/OUA 1989; Novisti 1991; APN 1991).

The main source of our knowledge about medicinal plants comes from our ancestors. The process of passing on information carries with it inherent weaknesses — a lack of standardization of ingredients and of medicinal preparations; a lack of accuracy in determining dosage; and the qualitative variation in the make-up of medicinal preparations (because the treatment may also include material or parapsychological elements — part of the rites and beliefs of everyday life) (Ahyi 1991; Novisti 1991). Despite these weaknesses, medicinal plants are still used in Africa and are becoming, in many developed countries, the means to cure ills like cancer, cholera, coughing, intestinal parasites, and hepatitis.

Even if detractors of traditional medicine and medicinal plants consider this medicine to be heretical and these plants to be weeds, we have no choice but to recognize that many species provide the basic ingredients required for the preparation of well-known drugs. This is certainly the case for eserine, cortisone, reserpine, quinine, morphine, digitalis, or of essential oils that are pure, natural, volatile, and odorous (Novisti 1991; Ford 1975; Le Floch 1983).

The leaves of *Cardiospermum grandiflorum* (left), ground up in water with the the leaves of *Gouania longipetala noofina* (malinke), are used to wash the sick to keep them from wasting away. Steeped in cold water, they are considered a cure to female infertility. Dried, they are used to combat the flu. (Photo: Kolie Cece)

Several species of essential oils, still almost unknown or that have not yet been studied, deserve to be included in official pharmacopoeia. Even though the chemistry of these medicinal plants is still a mystery, most scientists only concern themselves with plants that contain active compounds that can be easily extracted. In the absence of a predominant and obvious molecule, trying to determine how plants will be most effective almost always requires a huge amount of work. There is no doubt that a lot of discoveries are yet to be made in this wondrous world.

We should nevertheless ask ourselves the following questions: Are medicinal plants an inexhaustible resource? and; What should we do to avoid their destruction?

There are about 216,634,000 hectares of classified forests in Africa. Unfortunately, almost 1% of these are cut down every year. In Guinea, the speed of destruction seems to be close to 4%, whereas in Nigeria and Ivory Coast, it reaches an average of 5.7% (Iwu 1993).

The *Casia alata* L. plant (above) is considered to be a cure for dermatosis (crushed green leaves are applied directly to the affected areas) and constipation (the leaves are boiled down and the extract taken orally). (Photo: Kolie Cece)

These statistics speak for themselves. They explain why yesterday's plants are not always found today, and why today's plants may not be alive tomorrow. Thus, if we are talking about plants useful to humans — be they medicinal plants, food plants, or industrial-use plants — it is clearly because they exist. That is why it is important to protect this resource, as well as the individuals familiar with it — the healers and their knowledge. Because plants and healers are disappearing at a rapid rate, and because the protection of both plants and healers is so important, UNESCO has included this in a wide-ranging program — the Man and the Biosphere Programme (MAB). The rapid disappearances make it necessary to do an inventory of the thousands of plants and to do so as fast as possible; if this is not done, we risk seeing a vast source of information disappear forever (Pelt 1992).

This situation calls out to today's scientists to study even the plants that contain numerous compounds, using a more subtle approach, which would correspond to the current environmental consciousness. It is in this context that we carry out research at the University of Ottawa on plants likely to help solve the problem of chemoresistance, such as the resistance to several quinine-based drugs that the *Plasmodium falciparum* parasites (the cause of malaria) have developed. It is also this idea that has led us to undertake research on the extraction, isolation, and characterization of new plant-based compounds to beat the unbeaten and tricky human immunodeficiency virus (HIV). Surely nature must harbour a surprise in the fight against this disease.

There are many techniques widely used today to analyse plants and their derivatives, such as nuclear magnetic resonance spectroscopy and mass spectrometry (used jointly with high-performance gas or liquid chromatography), X-ray, infra-red, and ultra-violet spectra. These give us a clear picture of the most intimate structures of the plant's chemical molecules. The availability of all these techniques at the University of Ottawa has allowed us to characterize a series of anthraquinoleic compounds in *Morinda morindioides*, widely and successfully used in Africa for the treatment of malaria.

Our next book, entitled *Plantes médicinales de l'Afrique de l'Ouest*, will deal with more than 700 plant varieties and will provide invaluable information on traditional medicine in Africa. It is a work that we consider important to protect the knowledge of healers and traditional practitioners, and to encourage the development of this knowledge for the well-being of all.

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ECO-PRODUCTS

Eco-Foam, duplex printers, and energy efficient computers

From time to time, Global biodiversity *intends to run an article called Eco-Products. The purpose of this is to introduce products that readers may wish to consider for their environmentally friendly qualities. These will be products that we have run across or to which our readers have drawn our attention.* Global biodiversity *provides no warranty that these products* are *environmentally friendly, having no test labs of our own, only that they are worthy of consideration. So let the reader be advised to investigate more fully, and please — let us know if you have any products you think are beneficial in the fight to preserve and conserve biodiversity. [D.E.M.]*

ECO-FOAM®

Most of us are aware of environmentally unfriendly foam products, such as the CFC-emitting and static-clinging polystyrene used for packing and cushioning objects during shipping. These packing bits often escape and "decorate" the landscapes and seascapes of the planet.

A new, more environmentally friendly packaging foam, Eco-Foam® has been developed by American Excelsior Company. This foam is 99% starch, made from corn. The foam is non-toxic, breaks down readily on contact with water, can be composted, or better yet, re-used. It is puffed up using a simple heat and steam process. Since it is made of starch the foam is anti-static, which means it does not cling. The foam is made in extruded peanut style for regular packing use, but is also available in a stiffer form, coloured, and in sheets and planks; we have not checked to see if non-toxic coloring agents are used for the last two products.

Our test showed that Eco-Foam does break down rapidly in water. In natural waters or soils the starch would presumably be broken down by microorganisms, so could be considered biodegradable.

In consistency it is a bit softer than polystyrene foam. Held under a match, the Eco-Foam burns. On sampling it was virtually tasteless — although the product is not intended for ingestion, consumption of a small amount is said not to harm children, adults, or pets. For more information about Eco-Foam, contact: Mr. Ken Starrett, Director of Marketing, American Excelsior Company, 850 Avenue H, East, P.O. Box 5067, Arlington, Texas, USA 76005-5067, USA, Tel: (817) 640-1555. [D.E.M.]

DUPLEX PRINTERS

The July 1996 issue of *Byte* magazine (p. 32) gives business reasons for replacing simplex printers, printers that print on one side of a page, with duplex printers, those that automatically print on both sides of a piece of paper. But are duplex printers are as good for biodiversity as they are for business? Of course.

The world's forests are being reduced by 17 million hectares per year, yet the demand for paper will grow about 40% between 1990 and the year 2000. That means wood-pulp demand will be pushing tree harvesting faster than forests can mature. That, in turn, means less habitat for forest species.

Eco-Foam®, a puffed up starch product made as an alternative to polystyrene. A few seconds after being dropped in room-temperature water, it begins to disintegrate, demonstrating its biodegradability. (Photo: D.E. McAllister)

Duplex printing halves the amount of paper needed for most printing jobs. It will decrease the envelope size needed for mailing many documents. The weight of documents shipped by courier, mail, etc. will drop, decreasing transportation energy demands, and, in turn, reducing the output of carbon dioxide, and lowering rates of climate change with all its impacts on biodiversity. Used paper should be recycled, but if it is not, then at least the amount of paper going to the dump will be decreased.

A quick search of the Internet produced this list of duplex printers: Dataproducts Typhoon models 30D, 40, and 60; Lexmark's Optra printers with duplex option; Tally Page printers 9030D and 9040D, Brother Laser printers HL-960 and HL-1260 with optional duplex unit. Most of the duplex printers tend to be higher speed and more expensive. The other option is to buy a printer or use software that prints first the odd-numbered pages, manually return those pages (correct side up) and print the even-numbered pages. The manual mode saves paper, but takes a bit more time, and has the risk on the second printing that occasionally two pages will feed through together, meaning subsequent pages will be printed on the wrong page. Consumers should push for implementing automatic duplex printing in lower end printers. [D.E.M.]

Dataproducts duplex printers, the Typhoon 30 and the Typhoon 60.

ENERGY EFFICIENT COMPUTERS

The US Environmental Protection Agency (EPA) has sponsored a line of energy-efficient computer systems that reduce air pollution by "powering down" when not in use. Over 2,000 computers, monitors, and printers have earned the right to bear the EPA's Energy Star logo. These devices go to sleep when not in use and wake up with a simple touch of the keyboard or mouse. To receive a list of available products call the Energy Star Hotline at (202) 775-6650. [D.E.M.].

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Evolution will not evolve us

Anurag A. Agrawal, University of California at Davis

> *Humans have so far escaped many of the evolutionary restraints to which other organisms are exposed. But we are fast approaching those limits. Do we evolve culturally to live within these limits? [D.E.M.]*

Humanity is nature. There is nothing unnatural about humans and their actions, even their destructive ones. We are but one of the millions of evolutionarily fine-tuned works of random biotic art, and I will argue that what distinguishes us from other species is not that we are unnatural in our destructive tendencies, but that as a species we are falling prey to unguided freedom. I will also argue that humans have reached a "point of no return" in the sense that we are beyond the benefit of natural selection.

One could call the largely unpredictable (or at least genetically unprogrammed) behaviour of humans acts of free will, lack of biological determinism, or blank computer disks! Whatever you call it, humans have evolved into a destructive species, thereby ensuring our survival. Maybe that is what was intended. After all, exploitation is part of nature; destruction is, too. Take, for example, the often mutual relationship between pollinating insects and flowers: the insects consummate the flowers' version of sex. As an attractor or reward, nectar is an expensive sugary soup produced by the plant to ensure a happy marriage and the mixing of hopefully beneficial genes in the progeny. Many flowers have even specialized their shape and size to accommodate a narrow array of responsible pollinators. And yet into this productive and harmonious partnership, come the "cheaters."

In this case, the cheaters are not clever thinkers like humans, but clever arrangements of evolutionary genetic programming that allows them to exploit their version of an "oil well." By specializing in cutting the base of the flower, these thieves or "nectar robbers" have found a way to drain the nectar without providing the pollination. What would be the result of over-exploitation in this situation? A situation that I am sure has occurred numerous times in evolutionary history: the robber enjoys a period of high population and prosperity and the population of flowers remains stagnant for some time. Without an upper limit on the exploitation of the destroyer, and without a lower limit on the reproduction of the flowers — eventually both populations crash and fall extinct. And yet, as part of the endless evolutionary timeline, there have been some delicate balances struck whereby a flower, its pollinator, and even its floral nectar-robber can each exist without demise. Although there are endless examples, I will not further discuss the destructive and even cannibalistic nature of many of our evolutionary relatives.

Bombus occidentalis robbing *Ipomopsis aggregata* (Photo: David W. Inouya)

Humans are parasites, and parasitism is an integral part of nature. There is nothing dirty, evil, or intrinsically negative about parasites. Remember, though, that the best

The Canadian Museum of Nature is pleased to provide an open forum for diverse viewpoints even though they may not represent the views of the Museum itself. Comments on these viewpoints are encouraged. Please mail or fax them to the managing editor (address on page 1).

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Here, *Bombus occidentalis* is robbing *Delphinium nelsoni* (Photo: David W. Inouya)

parasites keep their hosts alive: a parasite without a host is a predator with no more food. Curiously, humans seem bent on destroying the Earth, our host. Do we simply exploit our host out of need?

Are human beings programmed for destruction? And if so, what does this mean for our survival? Is it bad or wrong? For most of humans' time on Earth under low population levels, we have exploited without consequence. Metaphorically, we had left enough flowers and pollinators to ensure our and their reproductive success. With a burgeoning population, this situation is changing. We are poised to be the instruments, direct and indirect, of extinction for many species. Possibly our own.

Is that a bad thing? Extinction is not really taboo, it is only part of a natural cycle. Let us not forget that our species is part of "the cycle" — only with the blessing or curse of freedom to override evolutionary forces (guns, eyeglasses, bulldozers, etc.). Oil, wood, and cultivated shrimp from ponds are our equivalents of the nectar-robbers. Do I argue for the end of mining, forest clearing, and damming of rivers? Of course not. This would simply be a reactionary view equal to the call for no nectar for the nectar-robber. But perhaps we have gotten too good at beating natural selection — accelerating our cause with little regard to our symbiotic partners.

Are we doomed to extinction so soon? If so, it will not be caused by natural selection, but by self-imposed thoughtful selection, untrammeled freedom. Like other organisms, we manipulate the animate and inanimate world around us. Parasitism, mutualism, and extinction are all of part of the cycle in our hands. The evolutionary process did not hard-wire humans to build things like computers — it only gave us the potential hardware required. The same "technology" will either lead us to conservation or extinction.

The basis for conservation must be a society rooted in a (simple) intellectual and ecological understanding of nature and its dynamics. Other anthropocentric and biocentric arguments promoting conservation exist — often cited are the pharmaceutical and economic value of biodiversity or the mystical beauty of the largely unexplored natural realm. I suggest that it will not be new cancer drugs or transcendental enlightenment that will pave the road to conservation, but rather a better understanding of the organisms and interactions that surround us. Human extinction in the next 1,000 years will not be due to fate. Plainly, we will have overexploited to our own demise. At this point nature can no longer fine-tune us (read, evolve us) to be any better, more responsible nectar-robbers — that is up to the inventors, engineers, and educators.

ACKNOWLEDGMENTS

Anurag A. Agrawal is a graduate student in population biology at the University of California at Davis and is currently studying the ecology and evolution of induced plant defenses against herbivores. He thanks U.C. Davis for support and Dan Janzen for inspiring ideas on conservation.

A "secondary nectar robber" takes advantage of the hole made by *Bombus occidentalis* to rob *Pensremon strictus* (Photo: David W. Inouya)

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New Release by the National Round Table on the Environment and the Economy

State of the Debate on the Environment and the Economy: Water and Wastewater Services in Canada

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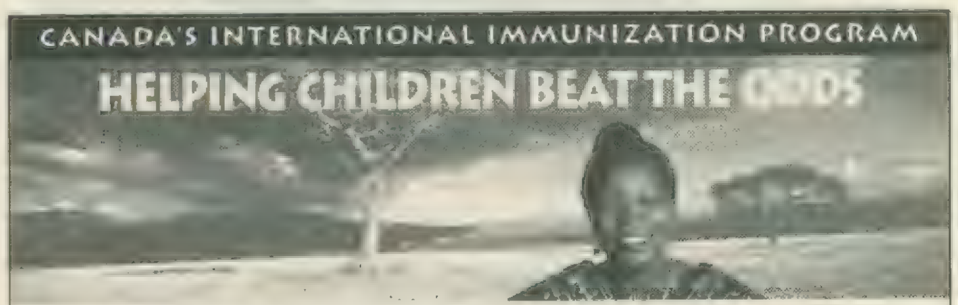
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THERESA BENJAMIN
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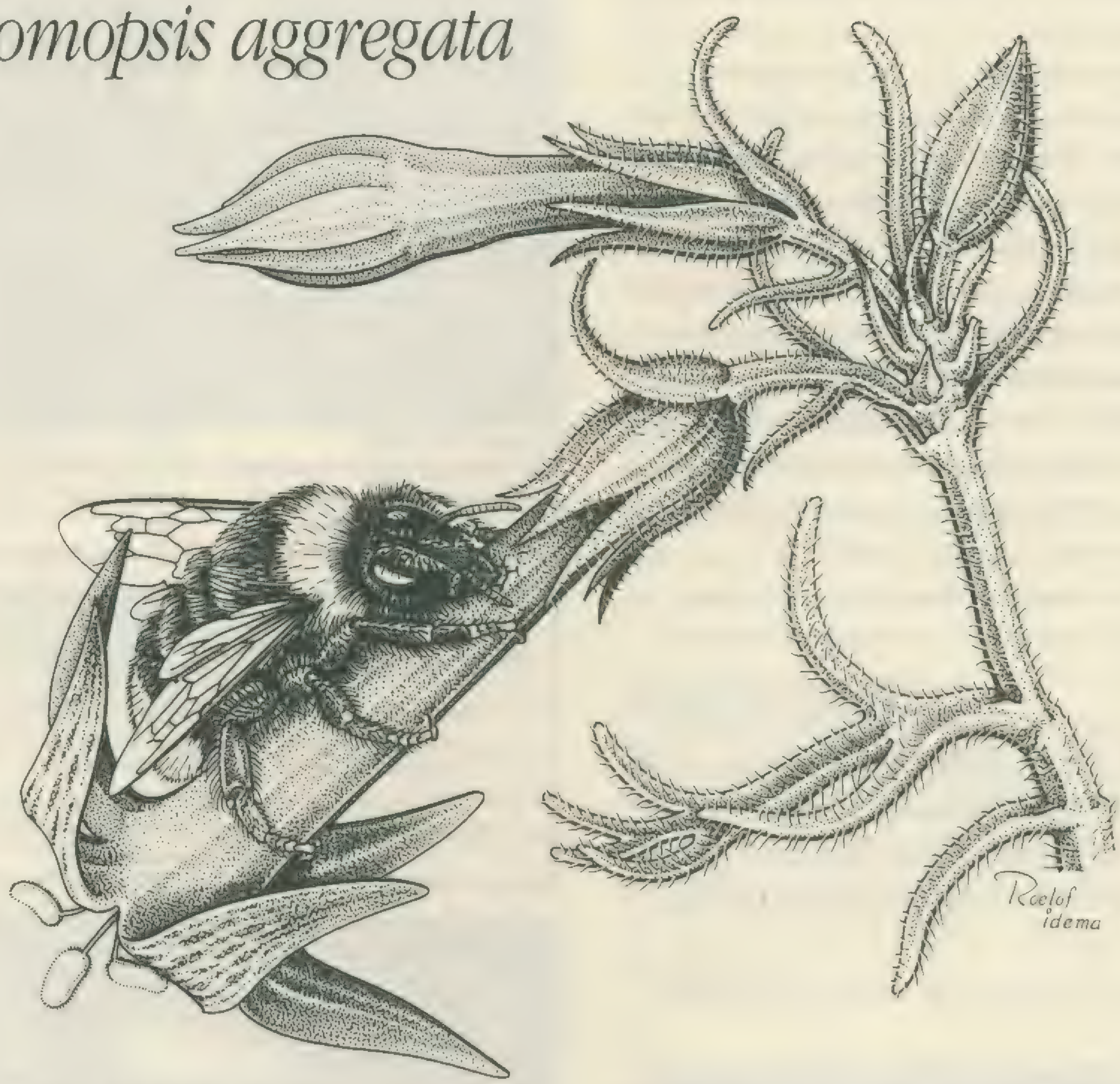
Bombus occidentalis robbing *Ipomopsis aggregata*



Nectar robbing is a strategy exhibited by some species of birds, bees, wasps, and other arthropods in which nectar is obtained through holes bitten near the base of corolla tubes of flowers. This process allows the robber to avoid contact with the sexual parts of the flowers. Flower forms have adapted to allow specific forms of pollinators access to nectar, thus rewarding the service of pollination. Some plant species have flower with sympetalous, or sealed, corollas, thus nectar robbing is the only means by which organisms not specifically adapted to those flowers can obtain nectar.

Primary nectar robbers bite through sympetalous corollas. Most are short-tongued bees, especially carpenter ants (*Xylocopa spp.*), and some bumblebees (*Bombus spp.*). Other primary robbers are insects, such as wasps (*Vespa spp.*), some beetles, and birds such as cinnamon-bellied and slaty flowerpiercers as well as honeycreepers. Secondary robbers use the holes provided by primary robbers, and are most commonly honeybees (*Apis mellifera*) and bumblebees. Some other insects such as honeybees and short-tongued bumblebees feed on polypetalous, or unsealed, corollas, but do not damage the corolla bases. These individuals force their mouth parts between the sepals and petals to get at the nectar source.

Primary nectar robbing exists because it is energetically efficient when there is a poor physical fit with the flower and no other nectar sources may be available. It appears to be a learned behaviour and is most common in nectar-feeding arthropods with short mouth parts. Though nectar robbing has only a slight negative impact on seed set, some plants have developed thicker corolla bases, presumably as a defence. Dense inflorescences, such as in clovers, protect against nectar robbing. In general, nectar robbing may promote a greater diversity of species, permitting, for example, two short-tongued bumblebees, one a robber and the other a specific pollinator, to co-exist.

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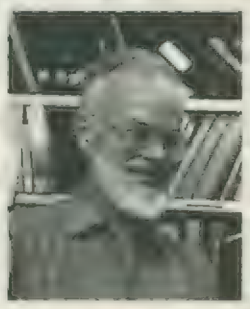


INTERNATIONAL CORAL REEF SYMPOSIUM

Dateline: Panama City,
24–29 June 1996
Reporter: Don E. McAllister

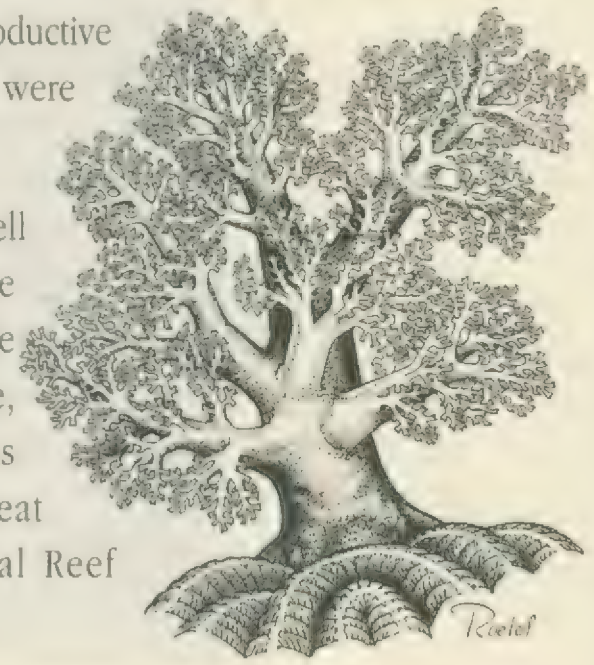
Over 1,400 persons from around the world attended the 8th International Coral Reef Symposium, and over 800 presentations were made in plenaries, scientific sessions, workshops, and posters. In addition, the Australian Coral Reef Society, Association of Marine Laboratories of the Caribbean, and the International Society for Reef Studies held annual meetings. There were also discussions on the International Year of the Reef '97 (IYOR '97) and the International Coral Reef Initiative (ICRI). The material available was extensive and plentiful. Topics are listed at the end of the report for those who may be searching for specific information on a certain topic in this area.

With up to 11 sessions happening simultaneously and individual consultations occurring in the corridors and being prolonged past coffee breaks, it was not possible to hear all the papers. Some of the interesting things I learned are:

- the latest estimate of the area of the world's coral reefs is 230,000 km^2 (less than half the previous estimate!);
- on 240 reefs the mean value for coral cover is about 40% (providing a rough baseline);
- bigger reserves give more robust yields in adjacent fishing areas but 40% of a reef set aside as reserve maximizes catches;
- there was a phase shift from coral- to seaweed-based reefs in the high islands of the southern Caribbean after 1988–1990 because of eutrophication;
- bumphead wrasse populations have plummeted because of cyanide harvest for the live food-fish trade and prices up to US $210 per kilogram;
- anecdotal surveys can provide quicker and less expensive results than standard monitoring methods;
- more than 25% of the diversity of coral in Indonesia is offshore; and
- the rise in global atmospheric carbon dioxide levels from 280 to 360 ppm over the last three decades has resulted in acidification of sea water with a 21% increase in H+ ions with an increase of almost 0.1 in pH.

One presenter suggested that the Spratly Islands, claimed in part or in whole by six southeastern Asian nations, should be established as an international marine park with a permanent moratorium on territorial claims. The park would benefit adjacent nations by providing an important source of fish and invertebrate larvae for restocking overfished reefs in the South China Sea and adjacent areas. It could also be of value in conserving biodiversity in conformity with the goals of the International Convention on Biological Diversity. Additionally, it would reduce chances of friction leading to military actions. The International Society for the Study of Reefs drafted a letter to be sent to President Ramos of the Philippines, recommending that construction of a cement plant near Bolinao and nearby productive coral reefs be reconsidered. (The plans were subsequently cancelled.)

All in all, the Symposium was very well organized. The host institutions, the Universidad de Panama and the Smithsonian Tropical Research Institute, and the many organizers and chairpersons deserve high compliments for the great success of the 8th International Coral Reef Symposium.



Paper and Symposium Session Topics

World reef status; Methods of study; Ecology past and present; Feeding/nutrients; Management; Fisheries/Fish; Sediments; Injury; Invertebrate Dispersal; Zooxanthellae; Sampling designs; Pest ecology; Coral biology; Disturbance Stress; ICRI; Remote sensing; Carbon cycling; Coral growth reproduction; Lagoons; Bioerosion Sea level; Biogeographic comparison; Marine protected areas; Skeletal records; Genetics and biogeography; CARICOMP; Taphonomy; Genetics Systematics; Databases; Calcareaous algae; Fish; Natural disturbance; Larval biology; Nutrient dynamics; Coral culture; Biogeography; Monitoring; and Fish dispersal.

Plenary Sessions

J. Corts on Biology and geology of eastern Pacific coral reefs; E.D. Gamez on The management of reefs in developing countries; R. Griggs on Paeleoceanography of the Hawaiian-Emperor Chain revisited; Héctor Guzmán on Crisis en la zona costera: Destruccon o conservacon?; S.P. Hubbell on A theory of immigration, extinction, and the relative abundance of species in rain forests and coral reefs; J.B.C. Jackson on Reefs since Columbus; Michael Lang on SCUBA: La ciencia y technologa de bucco; M.E. May on Seaweeds and the ecology and evolution of coral reefs; Don McAllister on Databases and analysis of geographic ranges of coral reef fishes: Virtues of points, grids and polygons for the IUCN's SSC Coral Reef Specialist Group; S.R. Palumbi on Population structure and molecular biogeography of the Pacific; B.G. Thatcher on Coral reef ecosystems: How much greater is the whole than the sum of the parts; B.L. Willis on Mating systems, hybridization, and species concepts in mass spawning reef corals; forum on Las communidades costeras y la conservacin de los arrecifes coralinos.

Workshops

Coral reef responses to global change: the role of adaptation; Coral reef science and management in Latin America; IYOR 1997; Rapid assessment, education, and outreach; Analysing long-term coral reef data sets; Marine protected areas: Function and design; Herbivory in coral reef systems; New perspectives on pathobiology of coral reef organisms; The role of bioerosion on recent and ancient reefs and its changing role on impacted reefs and the consequence of these changes; Environmental Impact Assessment and coral reefs.

THE SECOND WORLD CONGRESS ON THE PRESERVATION AND CONSERVATION OF NATURAL HISTORY COLLECTIONS

Dateline: Cambridge, UK
20-24 August 1996
Reporter: G.R. Fitzgerald

The Second World Congress on the Preservation and Conservation of Natural History Collections was held to bring "together leaders in industry, museums and related groups to discuss the future plans" and directions for natural history collections. The objectives were: to form a global network to support collections initiatives; to create a rescue and development group for collections requiring support and aid around the world; to improve lobbying for collections and funding at the government level; and to increase awareness of collections and their role in research, industry, and education. The Congress was well attended, with over 300 participants from around the world, attesting to the concern about this valuable global resource among collections professionals.

The Canadian Museum of Nature (CMN) was represented at the meeting by Rob Waller, who presented a paper on "Developing Staff Resources for Collections Management" and Jerry Fitzgerald, who presented one entitled "Public and Private Sector Collaboration on the Development of a Canadian National Collections Strategy." The CMN team was completed by Bill Russell, representing our strategic partner, Digital Equipment of Canada. In addition six posters served to increase exposure of the work of Nancy Boase, Mike Shchepanek, Pak Yau Wong, and Rob Waller. CMN Vice President, Science and Education, Patrick Colgan chaired the session on "International Financing and Valuation of Natural History Collections."

The conference program was organized to address key issues from a variety of perspectives. For the opening session on "Perceptions and Attitudes towards Natural History," keynote speaker Prof. Nicolai Vorontsov, Vice President of the Russian Academy of Sciences, outlined several major achievements in science that have come from collections-based research. Jack Horner then went on to demonstrate the importance of collecting as much data as possible not only about the specimen but also about its environmental context. He also examined and the way emerging technologies are allowing specimens and data to be reexamined. Richard Leakey presented an interesting perspective on the social and moral conflicts that arise in developing countries when collections compete with issues such as funding for public health. Tim Radford looked at science from the perspective of the media and suggested that we are in the "Sheherezade" business (as in *1001 Arabian Nights*) — if we tell interesting stories, the public will listen. The second session of the morning was on "Value and Valuation." Sir Robert May gave a very interesting presentation on national funding and governmental attitudes toward collections and research. In the afternoon we had presentations on information technology in museums from the international perspective.

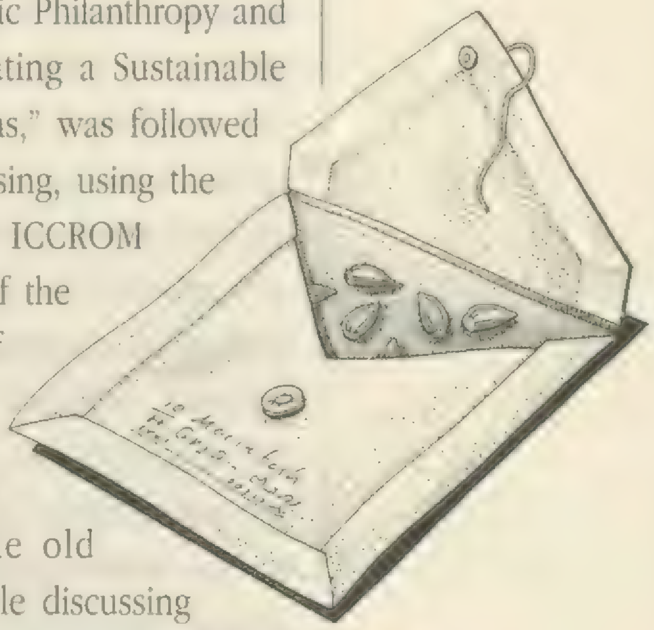
On the second day we looked at "collections as a resource," with presentations from industry and a look at how to market our work to industry. The ownership of collections and the role of collections as an international data resource were also discussed. In the afternoon there were presentations on "Future Directions in the Care and Management of Natural History Collections."

On the morning of the third day we heard presentations from participants from several countries in the developing world. Of particular note were talks by Demitri Geltman on "Collections in Eastern Europe," Lee Byung-Hoon on the National Museum in Korea, J. Mutangah on research and biodiversity in Kenya, and Jorge Soberon on Mexico's database development through CONABIO. In the afternoon Neil Chalmers gave an overview of the creative approach that the Natural History Museum is taking to address its funding problems. Terry Little presented the PREMA (Prevention in Museums in Africa) project and described how training is being accomplished in Africa. We are just beginning to see training responsibilities shift to participants who have been trained through the program. William Vartorella gave a presentation on fundraising, which then led into his workshop.

The last morning we had presentations on strategies that are being developed in Europe, and in Canada, and on the development of the ICOM Natural History Committee.

The final session of the Congress was an open meeting at which the progress (since the First World Congress that was held in Madrid in 1992) was reviewed and discussed. A motion was unanimously passed to create a task force that will define the agenda and objectives of a World Council on Collections Resources and that will evaluate the mission and functions of similar organizations. D. Griffin, Director of the Australian National Museum, and M. Isahakia, Director of the Kenya National Museum, were nominated and unanimously elected to co-chair the task force that they will assemble; members will represent a broad spectrum of nationalities.

The final session of each day was devoted to workshops. In the area of computers and technology there were demonstrations of The Jason Project, which links museum databases, video CDs, and other sources via satellite to bring "live" research into schools. There were also demonstrations of database systems, GIS systems, Web sites, and computer-aided learning packages. In the area of collections conservation there were workshops on pest control, testing materials for storing and displaying objects, assessments and surveys of collection condition, building environmental controls, and an opportunity to meet the UK conservation community. There was also an enlightening workshop on fundraising which was divided into two sections — the first, "Strategic Philanthropy and the Global Village: Tactics for Creating a Sustainable Future for Natural Science Collections," was followed with an example of practical fundraising, using the PREMA project developed through ICCROM (International Centre for the Study of the Prevention and the Restoration of Cultural Property, Rome).



There was ample opportunity for participants to meet and rekindle old friendships and make new ones while discussing issues in less formal settings — an important part of any Congress. The majority of participants stayed at St. John's College, where they had the opportunity to talk during breakfast and dinner. We also had the added experience of residing, if only briefly, within those historic halls. Participants were treated to a reception at the Fitzwilliam Museum, an Elizabethan evening, and a magnificent Congress dinner at St. John's College. There were also occasions when groups could simply meet in a local pub.

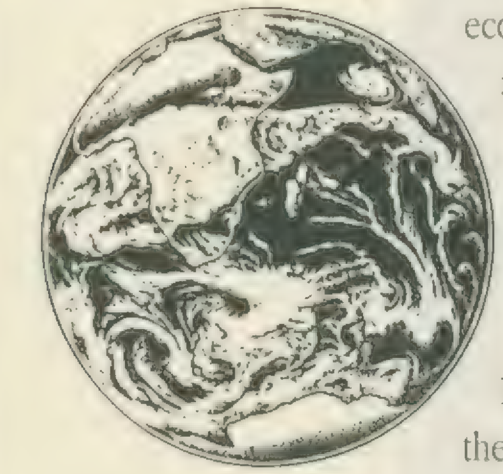
The success of the Congress was in no small way the result of the organizational skills and seemingly endless energy of Chris Collins, Congress Director, Margaret Johnson, Congress Administrator, and the local organizing committee. A newsletter has been established to provide information on the Congress and continuing developments that result from work of the task force. It is available on the Internet at <wccr-request@esc.cam.ac.uk>.

Throughout the Congress there were a few recurring underlying themes — fundamental issues that must be addressed by the international natural history collections community. These included funding for collections, increasing capacity in developing countries, collections as a world resource, and ownership of data and intellectual property rights. No doubt these issues will be hot topics for museum professionals for several years to come.

4TH GLOBAL BIODIVERSITY FORUM

Dateline: Montreal, Canada
31 August-1 September 1996
Reporter: Caroline Martinet

Over 180 individuals from more than 40 countries came together to attend the 4th session of the Global Biodiversity Forum (GBF) in Montreal. The forum, with four component workshops (incentives for biodiversity; marine and coastal biodiversity; forest biodiversity; and linking protected areas and people), developed recommendations for the meeting of the Convention on Biological Diversity's (CBD) Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) that followed the GBF on 2–6 September in Montreal. The overriding purpose of the forum and the workshops was to foster analysis, unencumbered dialogue, and debate among interested parties to address the key ecological, economic, institutional, and social issues related to the options for action to save, study, and use biodiversity sustainably and equitably.



INCENTIVES FOR BIODIVERSITY

This workshop focused on Article 11 of the Biodiversity Convention, which requires Parties to the CBD to create economically and socially sound incentives for conservation and sustainable use of biodiversity. (For more on this issue, see Frank Vorhies's article in *Global biodiversity* 6(2): 9–10.) Eleven case studies were presented from four continents on the implementation of incentives for conservation and sustainable use. Based on the case studies, participants identified a number of recommendations for the Parties and for the SBSTTA. They include recommendations for action at the national and local levels, and at the international level. In general, it is recommended that economic valuation is not a prerequisite for effective implementation of economic incentives under Article 11. Thus, Parties should move forward now with the implementation of Article 11. In particular, Parties need to identify and remove perverse incentives — most importantly, subsidies for ecologically unsound land-use practices. They also need to review and establish appropriate legal and institutional frameworks for enabling the implementation of effective incentive measures. The group especially supported the role of secure property rights and markets for biological resources, where appropriate. They also emphasized that incentive measures are critical for ensuring long-term financial and institutional sustainability, and that Parties need to incorporate equity considerations into the implementation of incentives measures.

MARINE AND COASTAL BIODIVERSITY

This workshop recommended that the SBSTTA initiate a process to define ecosystem management and to provide guidance on its use in different contexts. It was recommended that SBSTTA foster the development of global and regional systems for classifying marine and coastal systems to assist in conservation, management, and monitoring. SBSTTA should also ensure the two-way communication between scientists and users, including communities, managers, policy-makers, and indigenous peoples.

FOREST BIODIVERSITY

The group at this workshop pointed out that as the major reservoir for terrestrial biodiversity, forests are a central area of concern when it comes to meeting the objectives of the CBD. The Conference of the Parties (COP) should, therefore, adopt a framework for implementation and a work program on forests, building on the ongoing work of the Intergovernmental Panel on Forests (IPF) and other international processes. This program should cover the following areas: sustainable management of forest ecosystems and science; rights of indigenous and local communities; addressing underlying causes of forest biodiversity loss; and valuation and policy development.

COP should call upon the IPF to include rigorous consideration of conservation of biodiversity and forest quality in national forest- and land-use plans, and to give adequate consideration to forest ecosystem services, genetic resources, and the value of maintaining evolutionary processes. Furthermore, the SBSTTA should establish a working group on forest biodiversity to address the scientific, technical, and technological aspects of four areas: 1) criteria and indicators of forest quality, especially at the landscape and management unit levels; 2) the underlying causes of forest biodiversity loss; 3) the capacity for indigenous and local communities to help implement the CBD's objectives in their territories in accordance with their own laws and institutions, with legal protection of their collective rights; and 4) the restoration of forest quality and biodiversity in deforested and degraded lands.

BREAKING MYTHS: PROTECTED AREAS WITH PEOPLE

This workshop concluded that the modern approach to protected areas, which is now emerging in many countries around the world, is based on a three-part strategy: 1) broadening the range of categories of protected areas beyond the traditional focus on strict protection and national parks to include those protected areas in which people live and use natural resources sustainably; 2) broadening the approach to protected-areas planning and management by going beyond their boundaries and treating them as part of the larger ecosystem to which they belong, while at the same time addressing the needs of people and of biodiversity protection; and 3) broadening the number of partners involved in the establishment and management of protected areas, so that the role of national governments is complemented by the involvement of regional and local government, indigenous peoples, community groups, NGOs, and the private sector.

Common threads that emerged from several, if not all, of the workshops included agreement that the role of indigenous peoples should be based on the recognition of their rights to land and resources and their rights to benefit equitably from the sustainable use of the biological resources.

Another common thread was to welcome the decision by COP to adopt an ecosystem approach. This approach will enhance the integration of measures to protect biodiversity rather than being developed in isolation. This approach will also allow the synergies of proposed policies and actions to be recognized, and negative aspects avoided. In addition, existing policies and measures should be examined in this manner for possible disincentives and other aspects detrimental to the conservation of biodiversity. The ecosystem concept will facilitate the consideration of measures in the context of several objectives of the CBD. Thus, for example, protected areas should not only be considered in the context of Article 8 but also with respect to agricultural biodiversity and recognition of indigenous knowledge.

IUCN WORLD CONSERVATION CONGRESS

Dateline: Montreal, Canada
11–23 October 1996
Reporter: David Runnalls

More than 2,500 participants gathered for the first World Conservation Congress (WCC), organized by IUCN–The World Conservation Union. IUCN is in many ways the most influential international organization devoted to biodiversity and sustainable development. Its membership includes some 80 or so governments, as well as more than 100 government agencies (for example, the British Colombia Ministry of Environment, Lands and Parks became an IUCN member in time to participate in this year's Congress). More than 800 non-governmental organizations (NGOs) also belong to the Union. And, unlike other international organizations, the Union grants voting rights to its NGO members. One of the interesting tableaux in any IUCN meeting is to walk into the room and see delegates from Russia sitting next to those from the Metropolitan Toronto Zoo.

IUCN is also one of the oldest international conservation organizations. In 1998, it will celebrate the 50th anniversary of the Conference in Fontainebleu, at which the organization was created. And it has been holding triennial meetings ever since. The last was in Buenos Aires, Argentina in early 1993. So why was Montreal the *first* World Conservation Congress?

In Buenos Aires we decided that the Union needed to be more open to non-members and other organizations, such as development NGOs, which share many of the same views on environment and development. The Congress Steering Committee, therefore, set about to design an ambitious program of workshops and special events that were open to the press and the public. More than 1,000 people took advantage of this opportunity.

The Montreal Congress was actually four meetings in one, which increased the complexity accordingly. Without the truly outstanding work of the people from Parks Canada, the official host of the WCC, we could have had chaos instead of success.

COMMISSION MEETINGS

The first set of meetings was organized by IUCN's six Commissions. These Commissions gather together many of the world's leading experts on species, parks and protected areas, environmental law, education and communications, ecosystem management, and environmental policy. The Species Survival Commission (SSC), now chaired by David Brackett of Canada, has 7,000 members alone.

IUCN CONSTITUTION

We then spent two days (and a number of nights) revising the IUCN Constitution, an activity that we felt particularly appropriate to Montreal. The new Statutes of the Union have been developed over three years by a Committee of the Council and a series of meetings of members held in all regions of the world. After some bruising debates, the Union is now set to enter the new century with a modern Constitution.

BACKGROUND BUSINESS

Inevitably, some days of a conference such as this must be devoted to the humdrum affairs of running a complex organization. Reports on past activities were given, plans laid for future program areas, and the new President, members of Council, and the Chairs of the Commissions had to be elected. The members elected Yolande Kakabadse of Ecuador as the new IUCN President. Two Canadians were also elected to senior posts. Pierre Marc Johnson, the former premier of Quebec is now the Canadian representative on the Council, and David Brackett is the Chair of the SSC.

WORKSHOPS AND SPECIAL EVENTS

The heart of the Congress, in my view, was the four days of workshops and the special events. Many of IUCN's traditional concerns were addressed in the 57 workshops that covered such topics as sustainable use of wildlife, protected areas management, biodiversity, and ecosystems management. But we also used the workshops to expose members and the public to some of the broader economic and political frameworks within which conservation must take place. The role of economics in conservation, trade and environment, the relationship between structural adjustment and the environment in developing countries, and the future of development assistance all figured prominently in the program.

Previous IUCN meetings always featured a day devoted to the host country. Often these were ill attended and filled with rather dubious "scientific" presentations that were often thinly disguised propaganda. The Canadian members of IUCN decided not to take this course in Montreal. Instead, we organized three days of workshops on the theme of "Canadians and their Environment." The first day dealt with circumpolar issues and the use of traditional knowledge. The second looked at the role of protected areas in the modern world, and the third focused on planning for sustainable use in Canada. These workshops were well attended and, along with the National Round Table's workshop on the role of the private sector in environmental planning, gave the participants a good "warts-and-all" look at our experience in dealing with sustainable development.

The Congress Steering Committee also attracted some well known names to a series of "special events" that were held in plenary. Maurice Strong, former Secretary-General of the Earth Summit in Rio, chaired a panel on new ways of financing sustainable development. The panel featured interesting presentations. Representatives of the World Bank spoke on the Bank's new role in formulating voluntary environmental codes of conduct for private investors in development projects. Gus Speth, the Administrator of the UN Development Program, spoke about the relationship between poverty alleviation and sustainable development. Tessa Tennant, the British pension-fund guru, explained how her funds applied a sustainable development "screen" to all of their portfolio investments in developing countries. Readers may be interested to learn that investments in biodiversity preservation ranked high on her scale.

Another panel dealt with the role of the private sector, a topic hitherto verboten within the IUCN. Chaired by Stefan Schmidheiny, the Swiss businessman and founder of the Business Council for Sustainable Development, the panel featured presentations by William Ruckelshaus, former head of the US Environmental Protection Agency and by Jean Monty, CEO of Northern Telecom.

Finally, a distinguished panel of Sir Martin Holdgate (former director general of IUCN), Eddie Ayensu of Ghana (former chief scientist of the Smithsonian Museum of Natural History), Jose Sarahkhan (rector of the National University of Mexico), and Sylvia Earle (the distinguished marine biologist), speculated on the future of "Nature in the 21st Century."

RESOLUTIONS

And then there were the resolutions. Members sent in more than 130 resolutions on topics ranging from the protection of the Houbara Bustard to the need for IUCN to take a position on the "trade and environment" debate taking place in the World Trade Organization. The resolutions process in IUCN is fascinating to watch. In most international organizations, the NGOs are on the sidelines, lobbying governments to back one or another position. And they can be very effective gadflies. But in IUCN, the NGOs can vote. This means that governments must negotiate with NGOs in the same way that they must seek support from other governments. I was fascinated to watch the discussions that took place between representatives of the Sierra Club, the Western Canadian Wilderness Committee, the Natural Resources Defense Council, and the BC Government over Clayquhot Sound. In the end, they produced a resolution that passed unanimously.

In the end more than 120 resolutions passed in one form or another. Many of them were of direct interest to Canada. Perhaps the most controversial was a last-minute motion presented by the Federation of Ontario Naturalists and a number of other groups taking the Ontario Government to task for its recent decision to allow old-growth logging in Temagami. It also passed unanimously.

CONCLUSION

Two other Canadian issues figured prominently in the discussions in Montreal. The first relates to our oldest National Park. The Banff/Bow Valley Report was released by its Chair, Robert Page of the University of Calgary, just before the Congress. While the initial announcement by the Minister accepting some of the report's recommendations on the creation of wildlife corridors was well received by the IUCN parks people present, it is fair to say that they will be watching closely to see what the government does with some of the report's tougher recommendations.

Those who have followed IUCN affairs over the years may recall that in 1992 the Perth General Assembly did not ratify the membership of the Fur Institute of Canada after it had already been accepted as a member by the Council. After much debate the Fur Institute's membership was ratified in 1994. Montreal saw a recurrence of what is essentially an animal rights debate. Council had refused to admit the International Fund for Animal Welfare (IFAW) on the grounds that they did not subscribe the Union's view of the sustainable use of wildlife. This decision was challenged and an appeal against the Council's decision was heard at the WCC. After some debate, the membership voted overwhelmingly not to admit IFAW to membership.

So the first World Conservation Congress was a lively affair. We tried to do too much in too short a period of time, but we got away with it because of some hard work by Parks Canada and by a dedicated team of volunteers on the Resolutions and Statutes Review Committees. I think we sent away a group of pretty happy people — happy with what they'd done and where they had been. I was able to tell the Mayor of Montreal, who has had so much bad news lately, that he now had at least 2,000 international ambassadors for his city.

CONVENTION ON BIOLOGICAL DIVERSITY: COP-3

Dateline: Buenos Aires, Argentina
4-15 November 1996
Reporter: Désirée McGraw

Editor's Note: This article draws on the analysis written by the Earth Negotiation Bulletin (ENB) team in Buenos Aires, for which Désirée McGraw is a reporter. The ENB is a reporting service on multilateral environment and development negotiations throughout the world. For full ENB coverage of COP-3 (including Real Audio interviews and photos), check out the Linkages site at <http://www.iisd.ca/linkages/biodiv>.

If the first meeting of the Conference of the Parties (COP-1) to the Convention on Biological Diversity (CBD) established the basic machinery of the Convention and

COP-2 elaborated programming, COP-3 sought to address implementation in the context of these achievements. In the process, the COP began to come into its own, emphasizing both internal and external affairs.

INTERNAL AFFAIRS

Organization and programme of work

Procedural issues, pertaining to the ambitious agenda and the organization of work, were the focus of many discussions both inside and outside the COP-3 conference rooms. In its resolve to avoid COP-2's proliferation of working groups, COP-3 originally established only two. However, given the sheer volume of the agenda, additional consultations were conducted at the initiative of the Secretariat. Delegations, large and small, expressed frustration with their inability to fully participate given the lack of transparency in this consultation process. They further raised the concern that the process of consolidating positions is fundamentally political rather than administrative and, therefore, should fall within the purview of governments.

Still, any negotiating structure — no matter how transparent — would have been problematic given the scope of COP-3's agenda. In response to the problem of agenda overload, the COP set in place a procedure to gather participants' views regarding its internal operations and programme of work, thereby preparing the way for a COP-4 review of these issues.

Guidance to the GEF

COP-3 made several decisions in regard to its interim financial mechanism, the Global Environmental Facility (GEF), further illustrating its determination to manage its internal procedures. Last year, the GEF was simply presented with all COP-2 decisions, a procedure many observers discounted as inadequate in guiding the financial mechanism. This year, delegates conducted a systematic examination of its decisions in order to enable the COP to clearly define its expectations for GEF performance. Many delegates did not want to change existing guidance until the GEF's current performance is comprehensively evaluated. Based on the procedure established at COP-3, COP-4's review process may result in action to improve the effectiveness and responsiveness of the financial mechanism. Finally, the COP concluded a Memorandum of Understanding (MOU) with the GEF. Although some believed that a MOU was unnecessary, many delegates were pleased that the relationship between the two institutions has now been formalized.

Autonomy vis-à-vis UNEP

Throughout this past year, difficulties emerged in the relationship between the CBD Secretariat, now permanently established in Montreal, and its UN institutional home, UNEP in Nairobi. This led to a COP-3 decision that provides for the two entities to develop procedures to clarify and enhance their respective roles by 27 January 1997. The decision states that procedures should provide for the managerial autonomy and efficiency of the Secretariat as well as ensure the administrative accountability of the Executive Secretary to the COP. The parallel relationship between the UN and the Framework Convention on Climate Change (FCCC), on matters such as personnel and financing, is noted as an example to be followed. It is regarded as an arrangement that affords the Executive Secretary more flexibility and autonomy than do the existing CBD arrangements.

EXTERNAL AFFAIRS

COP-3's consideration of several substantive issues, notably intellectual property rights (IPR) and Article 8(j) (traditional knowledge, innovations, and practices of indigenous and local communities) as well as agricultural and forest biodiversity, is indicative of the Convention's aspiring role as a focal point among international treaties.

IPR/TRIPs

Many observers have speculated that the focus on IPR in the context of the CBD reflects a dissatisfaction among some delegations and NGOs with the Trade-Related aspects of Intellectual Property (TRIPs) sub-agreement to the GATT. Areas of concern included: the absence of an IPR regime that recognizes traditional knowledge; certain patent regimes regarding biotechnology-derived products; and whether the World Trade Organization (WTO) will consider the effect of global intellectual property regulations on the conservation and sustainable use of biodiversity. According to some delegations, there is an emerging consensus that, while the CBD will not be able to change the basic rules on IPR set down in the TRIPs agreement, it is appropriate for the CBD to have an opinion on environmental and sociocultural aspects of IPR and to communicate this opinion to relevant fora.

Plant genetic resources/FAO

Delegates also sent a message to the upcoming session of the FAO Commission on Plant Genetic Resources. At this session, the commission will be negotiating the revision of the International Undertaking on Plant Genetic Resources for Food and Agriculture in harmony with the CBD. One of the options under consideration is that the Undertaking, an FAO initiative, become a protocol on plant genetic resources under the CBD. Such a realization would not only reinforce the COP's position vis-à-vis FAO, it would resolve the outstanding status of *ex-situ* collections acquired prior to the CBD's entry into force.

Forests/IPF

COP sent a message to yet another intergovernmental body, this time regarding forest biodiversity. During discussion of the CBD's relationship to the Intergovernmental Panel on Forests (IPF), opinions differed as to whether the COP's decision on forest biodiversity represents a step forward or a missed opportunity. The decision's instructions on common priorities and advice to the IPF do little to elucidate the respective roles of the CBD and the IPF in forest biodiversity or to clarify the working relationship between them. To date, the CBD has been deferential to the IPF in promoting forest biodiversity as a priority. Some participants argue that rather than reacting to the IPF agenda, the COP should be more assertive in providing guidance to the IPF, particularly as the last of the scheduled IPF sessions draws near. Strengthening the CBD's relationship to the IPF could impact on the extension of the IPF or on the establishment of a similar international forum on forest issues, as was alluded to at IPF-3 in September.

LOOKING AHEAD TO COP-4

Numerous delegates suggested that one way to better manage the CBD's implementation would be to address cross-sectoral issues in the context of sectoral or thematic ones. For instance, technology transfer, finance, and incentives could be examined in relation to inland water ecosystems, a main sectoral theme for COP-4.

An example of the COP's honing of its work programme is apparent in the decision on this meeting's main thematic issue: agricultural biodiversity. Indeed, many stated that the decision is both more focused and realistic than the lofty Jakarta Mandate on Marine and Coastal Biodiversity. Indeed, the work programme for agricultural biodiversity set out in this year's decision clearly delineates action required of Parties and tasks to be carried out by the Secretariat. The decision places the responsibility for implementation squarely with governments — a distinction that has been blurred in the past — and, in so doing, may serve as a model for future decisions on sectoral issues addressed by the COP.

Another possible solution is to refer issues to subsidiary bodies. This approach has already proven fruitful in the case of biosafety. Based on terms of reference established at COP-2, the Biosafety Working Group has already made progress on the development of a biosafety protocol, and what was among the most contentious substantive issues at COP-2 was transformed into a primarily procedural matter at COP-3.

A Special Session of the UN General Assembly to review progress on Agenda 21 is scheduled for June 1997. Therefore, the Parties felt it was appropriate and timely for the CBD to also engage in an exercise of self-assessment and re-orientation. As the final decision on the COP's input into the Special Session notes, biodiversity is a cross-cutting issue that interfaces with several different facets of Agenda 21. Therefore, a substantive review of progress made thus far under the CBD would certainly be integral to the objectives of the Special Session.

The next meeting of the COP, in May 1998, will provide an opportunity for further review, as it will be the first time that national implementation of the Convention will be formally considered. This review will enable the COP to further organize and prioritize its agenda as well as clarify and reinforce the CBD's position vis-à-vis relevant international regimes.

The fact that so many constituencies find their concerns mirrored in the CBD led one delegate to characterize it as the "omnibus convention." Thus, the challenge for COP-4 is twofold: to focus its work programme and to cooperate with other international conventions — without sacrificing the CBD's comprehensive and cutting-edge approach to biodiversity.

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Biodiversity news

Biosystematics gets a boost

In Summer 1996, the Canadian Museum of Nature (CMN) joined forces with Queen's University in Kingston and the University of Kentucky in Lexington to create a new International Summer School on Biodiversity and Systematics. The school was designed to pique interest in biodiversity — specifically, biosystematics — and to boost the number of people working in the field. "We wanted to pool our expertise and resources to teach a new generation of students," says Dr. Steve Cumbaa, director of the school.

Classes (costing participants $3,000 for tuition alone) offered instruction on the theory and methods related to identification and classification of species, assessment of biodiversity, and the management of museum collections. Students came from as far away as South Africa and Malaysia. Many more were interested but couldn't manage to get funding. Most participants were university biology students, and a handful represented industry and government.

"This course isn't going to create experts in all topics covered," says Dr. Cumbaa. "But we expect that the broad knowledge base [the students] get will be the big pay-off." Plans are underway to run the school again next summer. Watch for details in the Spring 1997 issue of *Global biodiversity*. [Karen Hahn, Communications Dept., CMN]

Working Group on setting forest standards established by ISO

In June 1996 the International Organization for Standardizations (ISO) decided to create a Working Group under the leadership of New Zealand to help forest managers worldwide achieve sustainable forestry. "This is an important milestone in the quest for responsible stewardship of the world's forests," says Paul Perkins, Chairman of the working committee of the Canadian Coalition for Sustainable Forestry Certification. The Canadian Coalition includes 23 associations representing virtually all of Canada's forest industry.

The new Working Group will prepare materials to assist forest organizations in applying the new ISO 14,000 Environmental Management Systems standards. These standards will soon be used in manufacturing facilities to certify that they have a system in place to protect the environment. (See *Globlal biodiversity* 5(4): 28 for an alternative eco-labelling approach.) [News release, 28 June 1996, Sustainable Forestry Certification Coalition]

LCBO contributes over $147,000 to WWF-Canada and CNF

Through its "Help Save the Animals" campaign, the Liquor Control Board of Ontario (LCBO) collected $147,864 from its customers to support conservation work for endangered species. The majority of the total donated to World Wildlife Fund-Canada (WWF-Canada) and the Canadian Nature Federation (CNF) comes from product sales. The balance is from sales of LCBO t-shirts and wildlife calendars. In total, 17 different environmental projects will benefit — the largest single beneficiary being the University of Guelph Aquatic Sciences Research Facility. WWF efforts to protect the Eastern Beluga Whale and CNF's work in establishing national parks in Canada will also receive funds. [Press release, 25 June 1996, LCBO]

GEMCo formed to take action on global climate change

In June, an alliance of leading Canadian energy companies announced the formation of the Greenhouse Emissions Management Consortium (GEMCo). The group hopes to take action on global climate change by managing projects to offset carbon emissions, which will reduce, avoid, or absorb greenhouse gases. GEMCo believes that offsets can be a cost-effective, scientifically sound approach to this problem, which will encourage creativity and innovation as well as promote local economic, social, and community development. The group, presently composed of Canadian Utilities Limited, EPCOR, NOVA Gas Transmission, Ontario Hydro, SaskPower, TransAlta Corporation, and Westcoast Energy Inc., want to expand their membership. For more information, contact: Aldyen Donnelly, President, GEMCo, (604) 691-5066.

Green Teacher magazine seeking funding

The *Green Teacher* magazine, a priceless tool to help teachers and students learn about the environment, is trying to raise $20,000 after federal funding was cut back. The magazine operates on a shoestring, yet turns out a world-class magazine. Donors or subscribers may write to the address below to aid in the magazine's survival.

Green Teacher magazine originated in 1987 in a small village in Wales. The independent North American edition made its debut in February 1991; it is the only edition currently published. *Green Teacher* is largely the volunteer effort of many dedicated individuals, including 20 regional editors and more than 500 educators who have written articles or reviewed books over the last 6 years. *Green Teacher* has 1,800 subscribers in Canada, 400 in the United States, and 50 others around the world. Another 1,500 copies are sold at bookstores and conferences. *Green Teacher* won the 1995 award for Outstanding Leadership in Environmental Education from the Ontario Society for Environmental Education. For more information, contact: *Green Teacher*, 95 Robert Street, Toronto, Ontario M5S 2K5, Tel.: (416) 960-1244, Fax: (416) 925-3474, e-mail: <greentea@web.ca>; Web site: <http://www.web.ca/~greentea/>.

Crocodilians: Captive breeding or wild harvests?

The Crocodile Specialist Group (CSG) of SSC/IUCN has interacted closely with the CITES Secretariat and CITES Parties during the development of the Convention and its operating Resolutions. Driven by the success of sustainable use for the conservation of crocodilians (a group of reptiles that includes crocodiles and alligators) and the need for effective yet flexible regulation of international trade in crocodilian products, the CSG has been effective in assisting the Parties in developing a series of mechanisms to allow controlled trade. The CSG also assists the Secretariat and Parties in developing and evaluating programs and proposals. From this experience the CSG has been able to identify places where the Convention has succeeded and where it requires examination, and possibly modification.

While crocodilians are sometimes thought to be a rather special case when it comes to conservation and sustainable use, applying the general principles of the Convention to crocodilians has provided valuable experience that can now be applied to other organisms. To assist in the CITES review process the Steering Committee of the CSG has prepared the following guidelines for the constructive use of the reviewers and Parties in their efforts to improve the Convention. One of the guidelines deals with the issue of captive breeding.

CITES originally discouraged wild harvesting of crocodilians in favour of captive breeding, often *ex-situ*, on the grounds that this would relieve the pressures placed on the wild population by providing an alternate source for harvest. This strategy has often proved to be of very limited conservation value. It is now recognized that wild harvests, if well managed, can provide economic incentives to conserve wild populations and their habitats. Captive breeding, by contrast, can be useful for conservation, but may also detract from it. Despite the experience with crocodilians, captive breeding is still proposed as a valuable conservation action for other taxa. In some cases, this is resulting in a transfer of genetic resources from southern countries to *ex-situ* facilities in developed countries.

Example

The establishment of captive breeding of *Crocodylus niloticus* in South Africa, Brazil, and Israel has done little or nothing to benefit conservation of this species in the wild (with the possible exception of farms in South Africa, which have educational value). By contrast, the ranching programs in Zimbabwe and

Papua New Guinea have been shown to directly benefit wild populations. Many of the *ex-situ* captive breeding facilities are now in competition with production from the Range States contrary to the spirit of the Biodiversity Convention.

Suggested action

CITES should actively encourage conservation through wild harvests unless this is shown to be impossible or otherwise inappropriate. *Ex-situ* captive breeding for commercial purposes should be actively discouraged unless real conservation benefits can be demonstrated.

Other issues were also raised in the June 1996 posting on the CITES Internet discussion list by the Crocodile Specialist Group. For more information contact: James Perran Ross, Executive Officer, Crocodile Specialist Group, Natural Sciences, Florida Museum of Natural History, Museum Road, Gainesville FL 32611, USA, Tel: (352) 392-1721; Fax: (352) 392-9367. [CITES discussion list]

U.S. State Department support for IUCN SSC Coral Reef Fish Specialist Group

The U.S. State Department has just provided a grant of US $25,000 to support production of a Global Overview of the Status of Coral Reef Fishes. Coral reef fishes contribute a major segment of the world's marine fish diversity and provide much of the needed dietary animal protein in many tropical countries. Yet coral reef fishes are being threatened by loss of habitat, overfishing, and other factors. The grant was made to the Coral Reef Fish Specialist Group (CRFSG) of the IUCN Species Survival Commission (SSC). The CRFSG is managed by Ocean Voice International, a marine environmental organization. The U.S. State Department grant makes a major contribution to finalizing the Global Overview of the Status of Coral Reef Fishes. It will enable completion of a survey of coral reef fishes and habitat in over 100 countries, being carried out by Dr. Patricia Almada-Villela. The grant will support a Geographic Information Systems (GIS) analysis of about 2,000 species of coral fishes being carried out by Julie Hawkins and Drs. Callum Roberts, Frederick Schueler, and Don McAllister. That database and analysis will help pinpoint the world's hot spots in coral fish diversity and human impacts. Those hot spots will help select the best sites for marine protected areas and prioritize marine conservation activities. The grant also permitted these scientists to make presentations on the country and GIS studies at the 8th International Coral Reef Symposium (for more information, see pages 25–26).

Considerable interest is being shown in the GIS database and the equal-area global grid developed Ocean Voice International and applied by the CRFSG, in regard to their utility for global biota databases, conservation applications, and biogeographic studies.

The grant will also permit the CRFSG to put up a home page on the world wide web, assist with communication and coordination costs, and to edit the Global Overview draft report.

The SSC, the CRFSG and Ocean Voice International are very grateful to the U.S. State Department and the IUCN for this grant. It will make possible substantive progress on the Global Overview and hasten the date on which it can be made available. The CRFSG hopes to finalize the draft by the end of 1996, and publish it, if funds can be located, in 1997. The CRFSG is seeking those publication funds as well as funds to complete the chapter on the effects of the marine ornamental industry on coral fishes. [D.E.M.]

Braille version of CBD launched

The first International Day for Biological Diversity (29 December 1995) marked the launch of a Braille version of the Convention on Biological Diversity (CBD) in English, French, and Spanish. This version is being distributed free to all blind people's associations around the globe. This is a remarkable event for a number of reasons. It is the first time that an international environmental treaty has been transcribed in Braille for the benefit of some 40 million blind people. Even the Universal Declaration of Human Rights has not yet been transcribed. Second, it is a wonderful example of global partnership involving a United Nations body, industry, and a blind people's association.

Contributions for the production came from the European Senior Advisory Group on Biotechnology (SABG), the US-based Biotechnology Industry Organization, the Japan Bioindustry Association, the Canadian Pulp and Paper Association, and the European-based Green Industry Biotechnology Platform. The CBD Secretariat is profoundly grateful for these contributions and for the precedent that these contributors have set. It looks forward to continued collaboration with industry and the private sector in furthering the objectives of the CBD. [CBD Secretariat]

Cyberdiversity:

Biodiversity and the Internet

Canadian Museum of Nature goes live on the Web

On 2 December 1996, the Canadian Museum of Nature (CMN) launched a WWW site on the internet. The site is an introduction to the Museum, and as such, it is split into four main sections: Research & Collections; Exhibits & Education; Information & Services; and Discover. The first three offer straight information on the Museum's research expertise, collections holdings, educational products, scientific services, and so on. This information will be updated on a regular basis by staff actively involved in these areas.

The fourth section contains a CMN current events newspaper, which will be updated regularly, called Extra! Extra!; "Eyeopeners," a section that provides a behind-the-scenes peek at exhibits, research, and collections work (now posted is a look at Kathy Conlan's current work in the Antarctic — what is the influence of sewage from McMurdo Station on benthic communities?); Nature on the Net (a library of hotlinks on nature subjects with a request for users to help us build this library); and Tell All and Win! (a demographic/opinion survey on the site).

Be sure to check out the *Global biodiversity* section. Besides posting the current Table of Contents and a subscription form, plans include the posting of one or two articles from future issues, with feedback and viewpoints encouraged before publication. Comments received through the Web will be included when the articles are published. Also in the works is access to a biodiversity citation resource database developed by the Canadian Centre for Biodiversity. This database has the potential of being thematically searched and should be a useful tool for all readers.

The site address is <http://www.nature.ca>. Visit the site and let the Museum know what you think. Tell your colleagues and friends, too!

Biodiversity Convention mailing list

Successful implementation of the Convention on Biological Diversity (CBD) will require broad and active participation from a wide range of stakeholders. To translate the legally binding obligations of the CBD into action, these stakeholders will need timely and solid information. This new list server, moderated by the BIONET Secretariat, will include a host of information ranging from information about CBD intergovernmental meetings, the CBD Secretariat, reports and analyses of CBD meetings, reports on recent events, lists of key contacts, issue-specific reports, and so forth. BIONET is counting on the users to provide material for posting.

The initial e-mail distribution will include about 1,000 individuals. However, this is an "open access" list, and any individuals or organizations are welcome to join. Send an e-mail to <majordomo@igc.apc.org> with the following message: SUBSCRIBE BIODIV-CONV <your e-mail address>. For more information, please contact Sheldon Cohen or Stas Burgiel, BIONET, 1400 16th St. NW, Suite 502, Washington, DC 20036/ e-mail <bionet@igc.apc.org>/Web: <http://www.bionet.org>.

BIRDNET — Up and flying!

BIRDNET, the Ornithological Information Source, presented by the Ornithological Council, can be accessed at <http://www.nmnh.si.edu/BIRDNET/>. The site contains information on the Council, several major professional ornithological societies, and government and NGOs involved with ornithology. Links to other related sites are also provided. Send questions, comments, and suggestions to Robert Hole, Jr. <rbh2@ra.msstate.edu> or <rhole@interacktv.com>.

UNESCO — IOC register of marine organisms

This growing list of marine organisms can be reached via UNESCO's home page at: <http://www.unesco.org:80/ioc/>.

Once there, first click on "Our Activities," next click on "Ocean Science in Relation to Living Resources (OSLR)," and finally click on "The UNESCO-IOC Register of Marine Organisms."

Biodiversity meetings

17–19 MARCH 1997

Fourth Thematic Conference on Remote Sensing for Marine and Coastal Environments, to be held in Orlando, Florida, USA.

Contact: *Robert Rogers, ERIM, Box 134001, Ann Arbor, Michigan U.S.A. 48113-4001, Tel: (313) 994-1200, Fax: (313) 994-5123, email: <rogers@erim.org>*

12–16 MAY 1997

Third International Conference of Science and Management of Protected Areas. Linking Protected Areas With Working Landscapes Conserving Biodiversity, to be held in Calgary, Alberta.

Contact: *Patricia Benson, SAMPA III Conference Secretariat, #552 – 220 4th Avenue SE, Calgary, Alberta, T2G 4X3, Tel: (403) 292-4519, Fax: (403) 292-4404, E-mail:<sampas@pch.gc.ca>*

3–5 JUNE 1997

Symposium: Fisheries Management under Uncertainty, to be held in Bergen, Norway.

Contact: *Geir Huse, Department of Fisheries and Marine Biology, University of Bergen, N-5020 Bergen, Norway, Tel: 47 55 58 44 04, e-mail: <Geir. Huse@ifm.uib.no>*

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Fax, e-mail, or mail your classified (typed or printed clearly) to: Anne Winship, Ad Manager, *Global biodiversity*, PO Box 3443, Station D, Ottawa ON K1P 6P4; Tel: (613) 566-4203; Fax: (613) 566-4763; E-mail: <biodiv@mus-nature.ca>.

Singles Network Single science nature enthusiasts are meeting through Science Connection, a nationwide network. Contact us for info: PO Box 599, Chester, Nova Scotia B0J 1J0; E-mail: <71554.2160@compuserve. com>; Tel: (800) 667-5179.

Clean Environment Mutual Funds For information on this exciting investment opportunity call or write Geoff Wilkinson at Regal Capital Planners Ltd., 100 Woolwich St., Guelph ON N1H 3V2; Tel: (888) 895-7787 or (519) 823-2790.

Healing the Sky and Saving Your Skin What can you do to protect the ozone layer — and yourself? For a free brochure, contact Friends of the Earth, 306 – 47 Clarence St., Ottawa ON K1N 9K1; Tel: (613) 241-0085; E-mail: <foe@web.net>.

9–20 JUNE 1997

Tenth CITES Meeting, to be held in Victoria Falls, Zimbabwe.

Contact: *CITES Secretariat, 15 Chemin des Anémones, Case Postale 456, CH-1219, Châtelaine-Genève, Switzerland, Tel: 41 22 979 9139/40, Fax: 41 22 797 3471*

10–12 JUNE 1997

International Symposium on Physics, Chemistry and Ecology of Seasonally Frozen Soils, to be held in Fairbanks, Alaska, USA.

Contact: *Dr. J.K. Radke, Soil Scientist, 210 National Soil Tilth Lab, 2150 Pammel Drive, Ames, Iowa, U.S.A. 50011; Tel: (515) 294-0213; Fax: (515) 294-8125; E-mail: <jkradke@iastate.edu>; Web site: <http://www.nstl.gov/frozen>*

13–18 JULY 1997

Symposium on the Antarctic and Global Change, to be held in Hobart, Australia.

Contact: *Secretary General, International Glaciological Society, Lensfield Rd., Cambridge, U.K. CB2 1ER*

20–26 JULY 1997

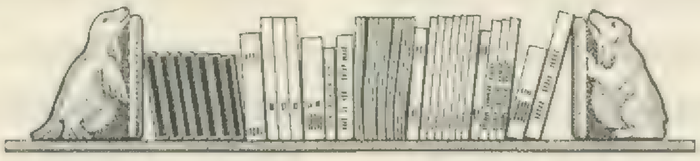
Coastal Zone '97, to be held in Boston, Massachusetts, USA.

Contact: *Dr. Martin C. Miller, USAE Waterways Experiment Station, Attn: CEWES-CR-O, 3909 Halls Ferry Road, Vicksburg, MS, USA 39180, Tel: (601) 643-3999, Fax: (601) 634-4314, E-mail: <m.miller@cerc.wes.army.mil>*

24–30 AUGUST 1997

9th International Congress of the European Society of Ichthyologists, to be held in Trieste, Italy.

Contact: *Pier Giorgio Bianco, Executive Secretary, SEI, Dipartimento di Zoologica, Via Mezzocannone 8, I-80134 Naples, Italy, Tel: 39 81 5527089, Fax: 39 81 5526452*



Book and periodical niche

National biodiversity planning: Guidelines based on early experiences around the world

World Resources Institute in cooperation with the United Nations Environment Programme and The World Conservation Union (IUCN). 1995. WRI Publications, Baltimore, Maryland. 161 pp. ISBN 1-56973-025-3.

All signatories to the Convention on Biological Diversity (CBD) are required in a legally binding fashion to act to protect biodiversity within each of their territories by performing an assessment of biodiversity (taxonomic and ecological census, economic factors, conservation costs, and unmet needs), developing a strategy, and implementing that strategy via an action plan. Organizing, coordinating, and compiling information can be a torturous and challenging job. While there are no formal UNEP guidelines for National Strategy or Action Plan development, the thorough UNEP Country Study Guidelines offer significant guidance. The challenge for ratified Parties to the Convention, then, is finding a way to organize and do the work required to conserve biodiversity.

This publication provides one answer. It is an invaluable and perhaps essential resource for countries wishing to work meaningfully towards the conservation of biodiversity by fulfilling their moral and legal obligations to the CBD. The "Introduction" provides instructions in using the guide, the cumbersomely titled "Relationships Among Biodiversity-Planning Tools and Between Strategic Biodiversity Planning and other Planning Efforts" details the steps required to organize all three stages of activities and lists resources that are essential for complying with the requirements of the Convention.

"Lessons Learned from Early Experiences" lists ten guiding principles gleaned from the earliest responses to the Convention, both obstacles to biodiversity planning and factors that were helpful in facilitating the work. It is an ironic and fitting reminder to any individual or department engaged in officious bureaucratic power struggles that the first guiding principle is: "Biodiversity strategies, action plans, or programs should improve and maintain the well-being of people and the productivity and diversity of ecosystems." This is really the basis of the CBD and of conservation biology. The resources that are being expended on such a wide scale on behalf of the Convention should always be directed towards this imperative.

"A Framework for National Biodiversity Planning: The Convention on Biological Diversity" gives a very brief overview of the CBD and provides checklists of action points. "An Illustrative Biodiversity-Planning Process: The Basic Steps" provides a simple planning model drawn from the experience and plans of participating countries. It documents examples of ways to nurture political commitment and the organization of working groups that could be directly used to integrate biodiversity considerations into national and regional planning. This chapter, essentially a workbook, is crucial for the development of the genuine political interest that will avoid disinterested, cursory participation that ultimately will be ineffective in reaching the desired goals.

The Annexes are also very useful. Annex A, "Profiles in National Biodiversity Planning," outlines the biodiversity plans or strategies of 17 countries, listing the institutional base, methodology, consultation groups and processes, relationship to national biodiversity planning, international assistance, and cost, personnel and time required. A sufficiently wide spectrum of countries (developed, developing, transitional, and small island developing states) and approaches are listed so that countries beginning the process should easily be able to tailor their own methodology. Annex B, with the lengthy title of "Background Information on Intergovernmental

Decisions and Corresponding Activities that Provide Overall Mandate for this Study," is self-explanatory. Annex C, "Criteria for Identifying Countries with Advanced Experience in Strategic Biodiversity Planning," outlines best-case scenarios for aspects of assessment, strategy planning, and assessment. It provides a model or goals to be attained. Annex D, "Pro Forma Questionnaire for Case Study Reports," allows for self-evaluation by the lead agency of a participating country for biodiversity planning. Annex E lists contributors to the publication, with telephone and fax numbers.

To people uninitiated into the mysteries of Articles, Preambles, *in-situ, ex-situ*, intellectual property rights, technology transfer, and other arcane jargon from the Convention and associated processes, this publication will be as dull as dishwater. For those people, I would recommend books and essays by E.O. Wilson, who captures the beauty and wonder of the natural world with unsurpassed skill. *National Biodiversity Planning* is essentially a technical manual that should be read by all signatories to the CBD and, perhaps, by those few countries that have not yet signed or ratified it.

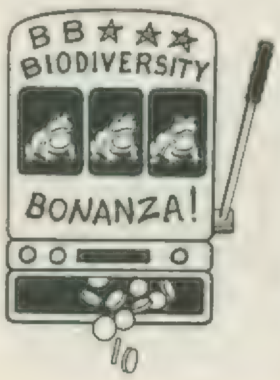
Noel Alfonso, Canadian Centre for Biodiversity, Canadian Museum of Nature

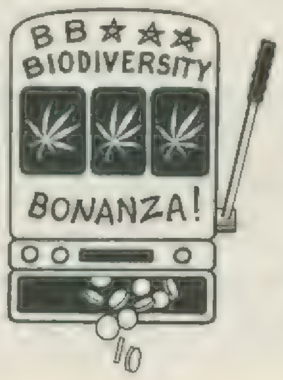
The economic value of biodiversity

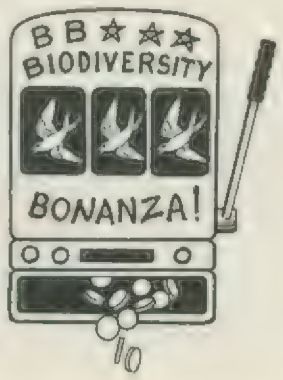
By David Pearce and Dominic Moran in association with the Biodiversity Program of IUCN. Earthscan Publications Ltd., London, 1994. ISBN 1-85383-1956, 172 pp.

If you are one of those people who don't understand why economics is important to the discussion on the environment, or don't understand the role of economics in these discussions, then reading *The Economic Value of Biodiversity* may be enlightening.

This excellent book contains all the key concepts and concerns considered by economists and others with an interest in seeing that biodiversity be accorded its proper worth. In a coherent and convincing form, the book presents most of the current leading thought on economic issues surrounding the valuation of biodiversity.







The book is organized into nine chapters dealing with such topics as: causal factors of biodiversity loss; conservation versus development; methodologies for economic valuation; estimates of biodiversity value; and capturing global environmental value. The volume starts with an introduction, which includes (to the pleasure of many biologists) a definition and descriptions of biodiversity — dealing with genetic diversity, species diversity and ecosystem diversity, and a section on measuring biodiversity.

Chapters 2 and 3 provide the essential theoretical economic background and reasons that biodiversity losses continue to occur. These two chapters form the core theoretical base that guides the remainder of the book — that is, they outline the methods, problems, and potentials of creating economic values for biodiversity that would make it comparable with other uses of the same resources. The authors explain several key economic concepts and principles explained in these chapters in a manner that non-economists should be able to follow. For example, they examine why unsustainable practices (e.g. clearing tropical forests for agriculture) are frequently preferable to sustainable practices (e.g. forest management for long term returns); why discounting future benefits can contribute to unsustainable development; how the differences between public and private, local, and global perspectives make huge fundamental differences in assessing biodiversity values; and why economic input is necessary to help resolve many of these issues.

Chapter 4 explains in economic terms some of the causes of biodiversity loss; details are given on market failure and intervention or government failure. Chapter 5 contains extensive text describing methodologies for economic valuation (direct and indirect approaches, contingent valuation methods, travel cost method, hedonic pricing, and other measures), including their data requirements, reliability, strengths, and shortcomings. This discussion provides a good summary of methods useful to economists and which should also be of use to non-economists.

Chapters 6 and 7 provide estimates of the value of biodiversity in various locations throughout the world, as reported in the literature and developed by the authors. The final two chapters contain some views on appropriating economic values globally and a summary and conclusions. These were a bit disappointing in that the conclusions were not very conclusive. The value in the book resides in its earlier chapters.

There is very little, if anything, in the book that is new. It is not original research; it does not present new findings, but rather a survey and interpretation of published reports and scientific journal articles. However, it does give lots of detail on the approaches, problems, and positive aspects of different valuations, as well as examples of valuations of biodiversity. It also develops some values for biodiversity based on the published data.

The book starts off by identifying the problem of dealing with the difference between biological resources and biological diversity, but does not really resolve the dilemma.

Unfortunately, few Canadian references are used. Further, no reference is made to the Canadian report to the UNCED, *Canada's Biodiversity* (Mosquin, et. al., 1992), which had a large section on the economics of biodiversity, and raised many of the methodological points discussed in the book. There is now quite an extensive literature on which to draw for a book of this nature.

There are some small areas one could quibble with (mainly a question of emphasis) and a few minor presentation glitches. The text would have benefited from some pictures or other graphics to break up the text a bit more. In general, however, the presentation is thorough and balanced; it provides a broad view of the issues concerning the economic value of biodiversity. It should be of interest to a wide public audience — economists, environmentalists, biologists and those studying these subjects.

Overall, the book is fairly easy to read, contains important information, and presents concepts and practical approaches to the valuation of biodiversity of which all environmental policy makers should be aware and understand. Recommended reading.

Peter G. Whiting, The Outspan Group, Stella, Ontario

Marine protected areas. Principles and techniques for management

Edited by Susan Gubbay, ed. 1995. Chapman & Hall, London, UK. 232 pp. Cloth ISBN 0-412-59450-1, UK £35.00.

Recent studies have brought evidence that the biological diversity of many marine ecosystems is comparable to that of the tropical rainforests. Moreover, the livelihood of hundreds of millions of people worldwide depends on the proper use of natural resources from coastal and offshore ecosystems. Yet, despite these facts, conservation of biological diversity in marine ecosystems has received little attention compared with that of terrestrial environments.

Around the world Marine Protected Areas (MPAs) are playing an increasingly important role in the conservation of marine ecosystems. Susan Gubbay is a specialist in coastal zone management, marine ecology, and conservation planning. Her excellent book is informative, concise, and appeals to the reader.

The book is composed of 10 chapters from various contributors — two co-authored by Gubbay — and encompasses relevant topics on the conservation of marine habitats and species. Through its 232 pages it describes the guiding principles behind the setting up and management of MPAs. Topics include criteria used for the selection of such conservation areas, legislative requirements, management, and enforcement. Two chapters are particularly invaluable and timely as they deal with marine education and interpretation as well as how to involve the community and encourage volunteer participation in marine conservation projects. One can read in Gubbay's book that "As land resources dwindle and coastal populations swell, there is a great need for awareness of human actions and their impacts on the oceans...it is a moral and economic mandate." One chapter also focuses on accommodating indigenous peoples' interests in MPAs. In addition, Gubbay's book includes case study examples of MPAs recognized for their overall success as well as others where numerous challenges and difficulties were encountered. Examples of MPAs dealt with in Gubbay's book include the Key Coastal Ecosystem of Belize, the Sultanate of Oman, a number of Marine Nature Reserves (MNR) in the United Kingdom, Balicasag Island Municipal Marine Park in the Philippines, the Great Barrier Reef Marine Park in Australia, and Key Largo and Loo Key National Marine Sanctuaries in the US, to mention a few.

Anyone who is keen on the conservation, management, or use of marine ecosystems or resources will find Susan Gubbay's work instructive, useful, and timely. I recommend *Marine Protected Areas* to conservationists, marine ecologists, and the general public who take at heart the conservation and sustainable use of our invaluable, often fragile oceans resources.

Dr. André Martel, Marine Biologist, Research Division, Canadian Museum of Nature

Losing ground: American environmentalism at the close of the twentieth century

By Mark Dowie. 1995. MIT Press, Cambridge. 400 pp. Cloth ISBN 0262-041-47-2. US $25.00.

Did American environmentalism take a wrong turn some time in the '70s? Mark Dowie, an environmental journalist and author of *Losing Ground*, argues emphatically that it did.

Dowie characterizes national environmental organizations as predominantly white, male, middle class, and too bureaucratic, too polite, and overly reliant on Washington lobbying. For Dowie these tendencies have estranged the mainstream movement from minorities and community groups fighting environmental issues across the country. In his view, the movement has lost the passion and democratic verve necessary to be a truly effective political force.

Losing Ground deals primarily with the last 25 years of environmental activity. National organizations grew rapidly in the '70s and '80s with much of the funding for green causes given to large associations like the Sierra Club, the National Audubon Society, and a handful of others. As membership swelled and staffing increased, these organizations focused most of their resources on a legislative approach at the federal level. Dowie acknowledges that legislative victories, such as the *Endangered Species Act* (1973) and the *Clean Air Act* (1970), were achieved, but argues that since the mid-'70s the legislative approach has yielded little in the way of success.

For Dowie, the Reagan era represented an acid test. Faced with a hostile President and massive cuts to green programs, national organizations failed, in Dowie's words, to go "mano a mano" with the President, but chose compromised access to government over no access at all. Things have not gotten much better under President Clinton. Supposedly friendly faces in the White House, most notably Vice-President Al Gore, have done more, in Dowie's view, to temper criticism of the Administration than to improve policy.

While some readers may find Dowie's assessment of national organizations harsh, his discussion of Washington lobbying and environmental fundraising make it clear that both can have a moderating influence. On the Washington lobby circuit, activists are often confronted with congress members and senators who do not have time for anyone with too radical a perspective. Fundraising also represents a double-edged sword as endowments and corporate donations often come with strings attached or are accompanied by appointments of corporate representatives to environmental boards.

For Dowie, hope for environmentalism lies with community groups, minorities, and other civil rights activists. Lois Gibbs, a housewife who led the fight at Love Canal, emerges as a prototype grassroots environmentalist. He points to the Principles of Environmental Justice adopted at the First National People of Color Environmental Leadership Summit in 1991 as a potential turning point toward a multiracial movement. Dowie feels that once national organizations are as concerned with the environments of urban ghettos as they are with wilderness areas, then American environmentalism can become a broad-based civil rights movement and a truly effective political force.

The emphasis of Dowie's argument is open to question at times. One suspects, for example, that the reformist approach employed by national organizations may be more in keeping with their membership's temperament than Dowie would like to believe. *Losing Ground* does, however, focus on an important problem for environmental organizations — their lack of political clout. Anyone concerned with why the movement has not been more effective in achieving fundamental change should find plenty of interest in *Losing Ground*.

Doug Mander, Toronto, Ontario

Species diversity in space and time

By Michael L. Rosenzweig. 1995. Cambridge University Press, UK. 458 pp. Soft cover, ISBN 0-521-49952-6. US $27.95.

Authors in many disciplines could use a similar title for a book, but the books written on the topic of species diversity would vary greatly. In this case, the author is approaching the subject from an ecologist's point of view, with the declared primary function of teaching students about past contributions in the field of ecology. While mention is made in places of earlier contributors to ecology, there is no real sense of the history of this field.

In the first 12 chapters of the book, Rosenzweig covers topics on patterns of species diversity from small to large areas, and over varying time scales, giving possible reasons for the patterns that are observed. These chapters are amply illustrated with many species/area graphs and equations to explain patterns. While most of the patterns may seem to be merely what common sense would dictate, the author does give examples of patterns that are the reverse of that expected, and gives explanations for these differences. These chapters could have been better organized; the first few chapters continually make reference to an explanation in a future chapter, causing the book to be a little repetitive in areas.

I tend to agree with the author's friend, who found the first 12 chapters of the book somewhat "unfulfilling" (p. 373). In fact, the last chapter (Chapter 13) was the most interesting to a non-ecologist, as it contained no graphs of species/area curves, only a few mathematical equations, and a cohesive summary of the knowledge and lack of knowledge in the subject area. This chapter is followed by 36 pages of references and a subject index.

Alison Murray, Canadian Museum of Nature

Global biodiversity assessment

By V. H. Heywood (Executive Editor) and R.T. Watson (Chair). 1995. Published for the United Nations Environment Programme, Cambridge University Press, Cambridge. 1,140 pp., illus. Paperback ISBN 0-521-56481-6.

This immense book, 21 x 26 cm and 6 cm thick and with over 1,000 pages involved the input of around 1,500 biological and social scientists from around the world. It is an unprecedented source of information on biodiversity.

The tome's thirteen chapters are: Introduction; Characterization of Biodiversity; Magnitude and Distribution of Biodiversity; Generation, Maintenance and Loss of Biodiversity; Biodiversity and Ecosystems Functioning; Basic Principles; Biodiversity and Ecosystem Functioning: Ecosystem Analyses; Inventorying and Monitoring of Biodiversity; The Resource Base for Biodiversity Assessments; Data and Information Management and Communication; Biotechnology; Human Influences on Biodiversity; Economic Values of Biodiversity; and Measures for Conservation of Biodiversity and Sustainable Use of its Components. Most chapters are preceded by an executive summary. References are given for chapters or sections of chapters; there is no overall reference list.

To complete the volume there is an index and glossary and annexes: Organization of the Global Biodiversity Assessment; List of Institutions and Staff Involved in the GBA Project; Venues, Dates and Participants in GBA Meetings and workshops; Contributors to the Global Biodiversity Assessment; and List of peer-reviewers of the Global Biodiversity Assessment. [Summary]

The value of life: Biological diversity and human existence

By Stephen R. Kellert. 1996. Island Press, Washington DC, 263 + xix pp., hardcover. ISBN 1-55963-317-4. US $24.95.

Subtitled "Biological Diversity and Human Society," this book gives much needed attention to the social aspect of biodiversity. The author is perhaps best known as co-editor, with E.O. Wilson, of *The Biophilia Hypothesis*, from the same publisher (see review in *Global biodiversity* 5(1): 37). As Kellert makes clear in his prologue, the book arises from his search for an integrity to all parts of a life that enjoys human activities and nature, a search surely of importance to all reflective individuals. Many of the sociological data subsequently cited have been collected by Kellert and co-researchers.

In the first of the three sections, on universals, Kellert usefully analyzes the basis for the regulation of wildlife. Most importantly, he looks at the impact humans have made on this wildlife, and at the major conservation efforts of the past two decades. He presents nine principle values held by people with regard to nature, ranging from utilitarian, to scientific, to moral, to economic and, to aesthetic aspects. The excellent discussion draws well on sources, includes a historical dimension with such key figures as Aldo Leopold, and considers the impact of the loss of diversity on the fulfillment of biophilia.

The second section, on variations, summarizes an American survey of attitudes toward nature in terms of demographic factors and changes over time. The differences resulting from education and ethnicity on attitudes are impressive, and these clashes reveal the basis of many contemporary controversies. Both formal and informal teaching institutions need to understand these attitudes as a motivational basis for their programming. Kellert goes on to consider major activities including hunting (contrasting hunters and anti-hunters), birding, zoo-visiting (with a good overview of value issues), viewing of powerful media, and abusing animals (and its unhappy association with violent crime). The factors shaping attitudes to given species are investigated, and well illustrated in the cases of the wolf, marine mammals, and invertebrates. The role of culture in generating unique perspectives from a common biological basis is excellently demonstrated by highlighting similarities and differences among the United States, Japan, Germany, and Botswana.

The third section, on applications, focuses on endangered species, conservation, and education and ethics. The impact and turbulent history of the US *Endangered Species Act* is considered in terms of case studies and lessons learned. Kellert laudably presents the increasingly severe encroachment by humans on the rest of nature (especially through cities), principles for the wise treatment of nature (including administrative goals and issues), and the great potential of both affective and cognitive education for inculcating healthy attitudes.

Overall Kellert eloquently, thoughtfully, and without sentimentality, examines the values underlying our attitudes to nature and consequent implications in a balanced manner. This social analysis does not treat, and is not intended to, fundamental issues in bioethics (such as the naturalistic fallacy), the enormous politico-economic problems of biodiversity, or the intense controversies about teaching values. Some readers will praise, but others will criticize, the absence of strong emotion in reaction to the massiveness of the destruction and the desperate harshness of the situation. All of those concerned with the human side of biodiversity will want to read this book.

Patrick Colgan, Book Review Editor

International environmental economics theories, models and applications to climate change, international trade and acidification

Edited by Ekko C. van Ierland. 1994. Elsevier, New York. 383 pp. US $168.50.

This book is the fourth in a series of books entitled "Developments in Environmental Economics." It contains essays by a number of writers, largely European, and deals with climate change, international trade, and acidification.

Part I, "Climate Change," explores the economic impact of various pollution abatement strategies upon trade in the industrial countries, since their relative costs will play an important role in decision making by their governments. The implications of these strategies are discussed, including: an international agreement establishing toxic emission abatement targets and the establishment of specific emission requirements for each of the nations that are signatories to the agreement; the imposition of a uniform international carbon tax followed by redistribution of the receipts; and a minimal carbon tax for each nation adjusted according to the quantity of toxic emissions produced. Other models are developed to gauge the effect of increasing information on the estimation of uncertain parameters (e.g. the severity of climate change and the cost of controlling greenhouse gases).

Part II, "International Trade and the Environment," investigates the impact of trade, trade policy, and environmental policy on trade patterns and the environment. The potential impact of environmental policies on national economies is discussed at length in Conrad's chapter on emission taxes and international market share rivalry. As pollution control and abatement expenditures are likely to increase the costs of production, and affect international competitiveness of industrial firms, environmental policies must take these into account in strategic planning. The dilemma facing politicians and environmental planners is aptly summarized in Bovenberg and de Mooij's argument: that the possible increases in employment and environmental quality accruing from the imposition of pollution taxes at the expense of distortionary labour taxes may be offset by reduction in private incomes. Of particular interest to Canadian readers might be the chapter by Kennedy that deals with the effects within a free-trade region of trade liberalization on pollution taxes, which has obvious relevance to the North American Free Trade Agreement.

Part III, "Acidification and Tradeable Permits," complements Part I in that it evaluates the effectiveness of various methods used to achieve specific environmental standards, with reference to the reduction of emissions of acidifying compounds such as sulpher dioxide, nitrogen oxides, and ammonia. The chapter by Amann et al. is especially interesting for its discussion of the best available technology (BAT) approach, which is proposed to reduce emissions of sulpher dioxide in Europe until exposure levels are attained that are safe for the natural environment. The adoption of a regional zoning of BAT standards throughout the European region could produce a solution that is reasonably cost effective.

The contributors to this book have attempted to discuss and analyse environmental problems, and to outline possible solutions. Presumably therefore, this book is directed at politicians, government policy makers, specialists in economics and, one hopes, informed members of the general public. However, the nature of international and environmental economics, which the editor, Ekko van Ierland, rightly acknowledges in the Preface to be complex, requires that simple and direct language be used so that the text can be clearly understood by non-technical readers as well as by experts. Instead, various crucial terms and concepts (e.g. "Nash equilibrium," "Lagrange multipliers," Pigovian taxation," and "externalities") are so ill defined as to be jargon to the non-specialist and even to specialists with other areas of expertise. At the very least, these terms should have been explained in a glossary or perhaps an extra chapter. Unfortunately, because of its largely theoretical and highly mathematical content, its heavy reliance on advanced knowledge of economics, and its often humourless and difficult style, this book may be valuable for specialized readers but will probably do little to enlighten members of the general public.

Dr. P. Martin, Ottawa, Ontario

Environmental Management in Canada

By Brett Ibbotson and John-David Phyper, eds. 1996. McGraw -Hill Ryerson Ltd. Hardcover. 259 pp. ISBN 007-551723-X. $44.99.

"*Everybody talks about the weather, but nobody does anything about it.*" This pretty well sums up what Canadians seem to believe about the natural environment. Certainly everybody is talking about it, but most people suspect that nobody is doing much about it. This book is directed towards helping those who are doing something about it, "those people who are responsible for designing, implementing, and maintaining environmental management systems for businesses and organizations in Canada."

The book contains, in addition to an introduction by the editors, twelve factual essays by different authorities on as many facets of practical environmental management. Chapter topics include: the regulatory and legal framework; environmental accounting, reporting, and auditing; public involvement and consultation; trade and environment; non-governmental organizations; organizational, operational, and cultural aspects of management systems in organizations; and case studies of successful corporate environmental management systems.

This book is a compact but highly informative introduction to current practices of environmental management within corporations. The work is oriented primarily towards the operation of industrial facilities. Environmental assessment of new projects is touched on very lightly. The concept of sustainable development is dealt with in the limited context of corporate policy and environmental accounting, largely ignoring issues related to global sustainability. Broader aspects of biodiversity, conservation, and land use planning are omitted altogether.

There are some intriguing anomalies. At first glance, it seems strange that the chapter on non-governmental organizations deals exclusively with standard-setting organizations, industry associations, and other business groups, without any reference to environmental non-governmental organizations (ENGOs). Similarly, the role of the ENGOs in public involvement and consultation is ignored. These omissions may be explained by the fact that public policy on the environment is largely taken as given, and the processes of policy-making are not dealt with.

The book's narrow focus is as much a strength as it is a weakness. The deliberate omission of broad-ranging issues allows the editors to cram much practical information and guidance for the practitioner into a package of modest size and cost. This is a successful trade-off.

Sweeping theoretical and moral soliloquies on sustainability are all too easy to find in the popular environmental literature. This book represents a refreshingly astringent antidote. Lay persons and students in any field who wish to understand industry's environmental management practices will find *Environmental Management in Canada* an appropriate introduction. It is required reading for all who aspire to generalize about industrial environmental performance.

C. George Miller, President, Mining Association of Canada

Green plans: Greenprint for sustainability

Huey D. Johnson. 1995. University of Nebraska Press. 233 pp. Hardcover, ISBN 0-8032-2579-2. US $30.00.

This book describes the green plans of the three countries that have taken this path: the Netherlands, New Zealand, and Canada. The book is divided in three sections. In the first, the author defines the problem in fairly classical terms: over population, misuse of energy, and others, and then uses examples from his own experience in California. "The destruction of the global environment is an enormous threat to our security as a nation and as a species." The second section describes the green plans in the Netherlands, New Zealand, and Canada. All these plans are presented in an extremely positive manner, almost rosy, or should we say, in this case, "green?" The green plans are presented as the way of the future and a major source of hope for our planet. It is refreshing to be able to be extremely positive with matters that are, in many cases, extremely negative.

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On many occasions, the style used in this book has a shockingly "big brother" imperialistic flavour. Sentences such as "Canadians have an almost mystical attachment to their natural environment: love for the land is part of their national identity" are insulting to me as a Canadian. I don't like to see Canadians presented as "loonies" who still trap their forests and who have never seen the world. I am sure that people from New Zealand and the Netherlanders may have the same problem with the way they are presented.

The third section is called "Identifying Ingredients for Success" and tries to describe the key factors associated with successful green plans. This section is interesting and spells out in general terms what should be done. It depicts the nuts and bolts of success as if we knew what they were.

Over all *Green Plans* is a very nice book filled with interesting information. However, it is an American book that tends to bring all human activities back to themselves. It is an interesting approach considering that many industrial countries use an American model for their development.

Jacques Surprenant, Ph.D., M.A.P., Program Manager, Crop Protection, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-food Canada

Some titles of recent note...

Des baleines, des bactéries et des hommes. 1994. By Robert Barbault. Éditions Odile Jacob. Couverture souple, ISBN 2-7381-0251-4.

Diversité biologique, Convention sur la diversité biologique: Projet de stratégie de mise en oeuvre au Québec. 1995. Comité interministériel sur la diversité biologique, Gouvernement du Québec, Ministère de l'Environnement et de la Faune. Couverture souple, ISBN 2-550-24557-1.

La conservationdes ressources phytogénétiques en France. 1995. Rapport à l'OAA, Bureau des ressources génétiques, Bureau des ressources génétiques, Paris, France.

CD-ROM sourcebook for the atmospheric, oceanic, Earth, and space sciences. Published annually by MeteoQUEST, P.O. Box 10360, Bedford, NH 03110-0360, tel: 603-471-1802, Fax: 603-471-1803. ISBN 0-9643356-1-1.

A global geochemical database for environmental resource management (Final Report of IGCP Project 259). Earth Sciences 19. 1995. UNESCO Publishing, Paris, 122. pp., ISBN 92-3-103085-X. 100 FF.

Canada and the Ramsar Convention. Canadian Wildlife Service, Environment Canada with Canadian Ramsar Network and North American Wetlands Conservation Council (Canada). 1995. 20 pp. ISBN 0-662-23423-5.

Towards conserving the birds of Ontario (discussion document). 1995. By Edward D. Chesky. Federation of Ontario Naturalists, Don Mills, ON. 48 pp.

A conservation assessment of the terrestrial ecoregions of Latin America & the Caribbean. 1995. By Eric Dinerstein, David M. Olson, Douglas J. Graham, Avis L. Webster, Steven A. Primm, Marnie P. Bookbinder, and George Ledec. The World Bank in association with World Wildlife Fund, Washington DC. 129 pp. Paper, ISBN 0-8213-3295-3. US $29.95.

African elephant database 1995. 1995. By M.Y. Said, R.N. Chunge, G.C. Craig, C.R. Thouless, R.F.W. Barnes and H.T. Dublin. Occasional paper of the IUCN Species Survival Commission No. 11. IUCN, Gland, Switzerland. 225 pp. Paper, ISNM 2-8317-0295-X.

Conservation of endangered species in captivity: An interdisciplinary approach. 1995. Edited by E.F. Gibbons Jr., B.S. Durrant and J. Demarest. State University of New York (SUNY) Press, Albany, NY. 810 pp. Paper, ISBN 0-7914-1912-8; US $34.95.

St. Lawrence Beluga Recovery Plan. 1995. St. Lawrence Beluga Recovery Team. Department of Fisheries and Oceans Canada, Mont Joli, Quebec, and World Wildlife Fund Canada, Montreal. 73 pp.

National biodiversity strategies: Guidelines for biodiversity planning and profiles from early Country experience. 1995. By Kenton R. Miller and Steven M. Lanou. World Resources Institute Publications, Baltimore, MD. 200 pp. Paper, ISBN 1-56973-025-3. US $19.95.

Sun power: The global solution for the coming energy crisis. 1995. By Ralph Nansen. Ocean Press, Ocean Shores, WA. 264 pp. Paper, ISBN 0-9647021-1-8. US $14.95.

Extraction & the environment: The economic battle to control our natural landscapes. 1995. By Thomas M. Power. Island Press. 350 pp. Cloth, ISBN 1-55963-368-9. US $29.95.

Nature in danger: Threatened habitats & species. 1995. Edited by Noel Simon. Oxford University Press. 240 pp. Cloth, ISBN 0-19-521152-9. US $35.00.

Mainstreaming the environment: The World Bank Group and the environment since the Rio Earth Summit. Fiscal 1995. The World Bank, Washington, DC. 301 pp. Paper, ISBN 0-8213-3290-2.

Ecology, conservation and management of Southeast Asian rainforests. 1995. By Richard B. Primack and Thomas E. Lovejoy eds. Yale University Press, New Haven, CT, 06520. 304pp. ISBN 0-300-06234-6. US $35.00.

THE LAST WORD

West Africa gets going

The variety of life on Earth is our insurance policy for survival. This is true whether we live in Canada or in West Africa. However, protecting this diversity in the underdeveloped countries of West Africa is a complex matter. Although underdevelopment is not the antithesis to the protection of biological diversity and the environment, it does present a challenge. It is not hard to understand why a country that is unable to satisfy basic needs of its population, has insufficient or non-existent infrastructures, and an illiteracy rate of 60% does not make protection and enhancement of its biological diversity a priority. Such is the situation in most developing countries; while conservation and sustainable use of biodiversity may be a political priority, it is often a different story in practice.

Of course, despite the practical hurdles, several of those countries have signed the Convention on Biological Diversity and have committed themselves to preparing a country study — two positive signs in themselves. The country study is the cornerstone from which to develop strategies for conservation and sustainable use of biological diversity, and to identify priorities. It is also a valuable tool in the field of environmental education, helping to make people, such as policy makers, managers, concerned citizens, financiers, and technicians, aware of the issues.

However, the mere commitment to preparing a country study and setting priorities does not mean conservation and sustainable use programs will become a reality. Only a few countries, such as Guinea and Burkina Faso, have actually begun the process of preparing a country study. In general, developing countries do not have sufficient resources to undertake such a study, or to develop a strategy. And yet, doing so is highly recommended.

The hydroelectric potential of several West African countries, coupled with their underground reserves, means that they are poised for economic development. Support must be given to these countries to ensure that political instability, population pressures, agri-food activities, forestry, fishing, industrial activity, mining, and urbanization do not have a negative impact on biological diversity. UNEP, UNDP and the World Bank can and do provide essential support in the area of biodiversity management. This is wonderful because without the conservation and sustainable use of biodiversity, sound sustainable development will be impossible.

Jean Lauriault

Jean Lauriault

Environmental Specialist

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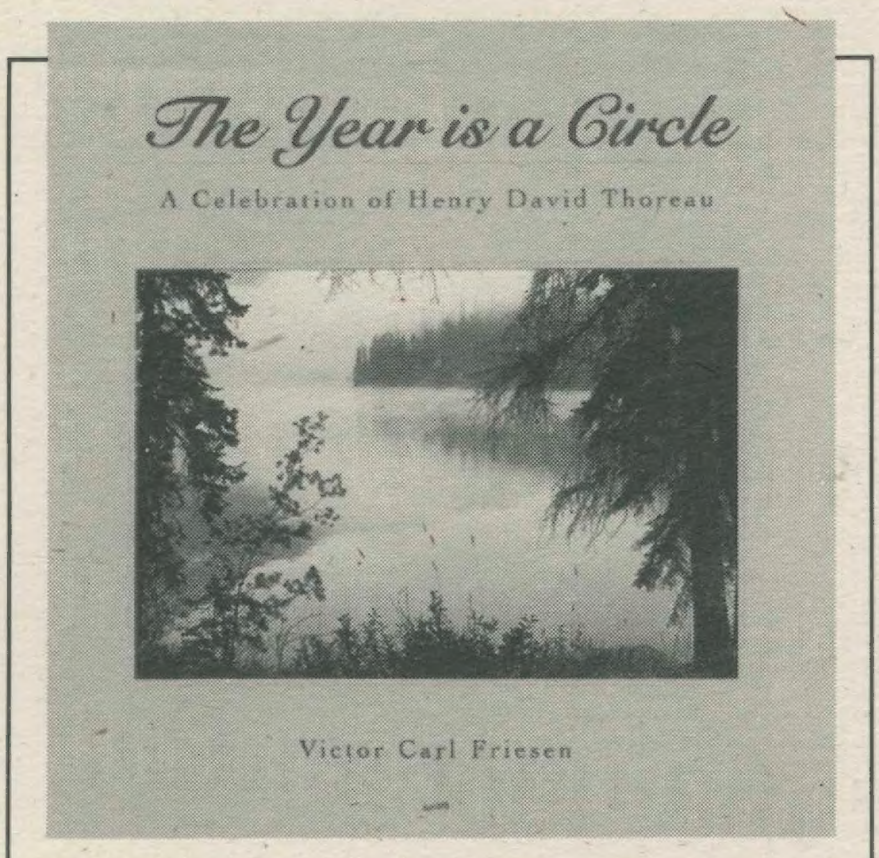

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Almost a quarter of South America is grassland and savanna. These ecoregions (termed *pampas* and *campos*) are unique among grasslands of the world because they did not, until the arrival of Europeans, support significant herds of vertebrate herbivores. Fire and a variety of herbivores, large and small, were the dominant forces shaping these vast areas.

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